NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

Bachelor of Technology Programmes

Syllabi and Regulations for Undergraduate

PROGRAMME OF STUDY

(wef 2012 entry batch)

Course Structure for B.Tech (4years, 8 Semester Course) Civil Engineering

(to be applicable from 2012 entry batch onwards)

Course No	Course Name	L	T	P	C
Semester-1					
CH-1101 /PH-1101	Chemistry/Physics	3	1	0	8
EE-1101	Basic Electrical Engineering	3	0	0	6
MA-1101	Mathematics-I	3	1	0	8
CE-1101	Engineering Graphics	1	0	3	5
HS-1101	Communication Skills	3	0	0	6
CH-1111 /PH-1111	Chemistry/Physics Laboratory	0	0	2	2
ME-1111	Workshop	0	0	3	3
	Physical Training-I	0	0	2	0
	NCC/NSO/NSS	0	0	2	0
		13	**2**	**8**	**38**
Semester-3					
MA-1201	Mathematics-III	3	1	0	8
CE- 1201	Building Materials and Construction	3	1	0	8
CE -1202	Surveying	3	1	0	8
CE -1203	Strength of Materials	3	1	0	8
CE-1204	Engineering Geology	3	0	0	6
CE-1211	Surveying Laboratory	0	0	2	2
	Physical Training –III	0	0	2	0
	NCC/NSO/NSS	0	0	2	0
		15	**4**	**2**	**40**
Semester-5					
CE-1301	Geotechnical Engineering	3	1	0	8
CE-1302	Structural Analysis -II	3	1	0	8
CE-1303	Transportation Engineering-I	3	0	0	6
CE-1304	Environmental Engineering-II	3	0	0	6
HS-1301	Business Management	3	0	0	6
CE-1311	Environmental Engineering Lab	0	0	2	2
CE-1312	Geotechnical Engineering Lab	0	0	2	2
CE-1313	Transportation Engineering Lab	0	0	2	2
		15	**2**	**6**	**40**
Semester-7					
CE-1401	Civil Engineering Estimation	3	0	0	6
CE-1402	Irrigation Engineering	3	0	0	6
CE-1403	Project-I	0	0	8	8
CE-1404	Foundation Engineering Lab	0	0	2	2
CE-14XX	Dept. Elective-I	3	0	0	6
CE-14XX	Dept Elective-II	3	0	0	6
XX-14XX	Open Elective-I	3	0	0	6
		15	**0**	**10**	**40**

Course No	Course Name	L	T	P	C
Semester-2					
EC-1101	Basic Electronics	3	0	0	6
CS-1101	Introduction to Computing	3	0	0	6
MA-1102	Mathematics-II	3	1	0	8
ME-1101	Engineering Mechanics	3	1	0	8
PH-1101/ CH-1101	Physics/Chemistry	3	1	0	8
CS-1111	Computing Laboratory	0	0	2	2
EE-1111	Electrical Science Laboratory	0	0	2	2
PH-1111/ CH-1111	Physics/Chemistry Laboratory	0	0	2	2
	Physical Training –II	0	0	2	0
	NCC/NSO/NSS	0	0	2	0
		15	**3**	**6**	**42**
Semester-4					
CE-1205	Structural Analysis-I	3	1	0	8
CE-1206	Hydraulics	3	1	0	8
CE-1207	Environmental Engg-I	3	0	0	6
CE-1208	Structural Design-I	3	1	0	8
HS-1201	Managerial Economics	3	0	0	6
CE-1213	Engg. Geology Laboratory	0	0	2	2
CE-1212	Hydraulics Laboratory	0	0	2	2
	Physical Training-IV	0	0	2	0
	NCC/NSO/NSS	0	0	2	0
		15	**3**	**4**	**40**
Semester-6					
CE-1305	Structural Design-II	3	1	0	8
CE-1306	Structural Analysis-III	3	1	0	8
CE-1307	Foundation Engineering	3	1	0	8
CE-1308	Transportation Engineering-II	3	0	0	6
CE-1309	Hydrology &Flood Control	3	0	0	6
CE-1314	Concrete Lab	0	0	2	2
CE-1315	Structural Engineering Lab	0	0	2	2
		15	**3**	**4**	**40**
Semester-8					
CE-1441	Elements of Earthquake Engineering	3	0	0	6
CE-1442	Structural Design-III	3	0	0	6
CE-1443	Project-II	0	0	10	10
CE-14XX	Dept. Elective-III	3	0	0	6
CE-14XX	Dept Elective-IV	3	0	0	6
CE-14XX	Open Elective-II	3	0	0	6
		15	**0**	**10**	**40**

NB: Industrial Training after Sixth Semester for a period of 4-6 weeks as an audit course.

E1111 will be jointly offered by EE and EC Departments

LIST OF ELECTIVES -

7th SEMESTER

Elective-I

CE-1411 Open Channel Flow
CE-1412 Adv Environmental Engineering
CE-1413 Traffic Engineering
CE-1414 Optimization Methods in Engineering Design
CE-1415 Ground Water System Management

Elective-II

CE-1421 Advanced Structural Analysis
CE-1422 Remote Sensing and GIS
CE-1423 Ground Improvement Techniques
CE-1424 Urban Transportation System Planning
CE-1425 Water Resource Development

Open Elective-I

CE-1431 CAD in Engineering

8th SEMESTER

Elective-III

CE-1451 Construction Management
CE-1452 Advanced Hydrology
CE-1453 Advanced Foundation Engineering
CE-1454 Bridge Engineering
CE-1455 Analysis and Design of Pavements
CE 1456 Design of Special Structures

Elective-IV

CE-1461 Hydraulic Structures
CE-1462 Elementary Performance Based Seismic Design
CE-1463 Concrete Technology
CE-1464 Numerical Methods

Open Elective-II

CE-1481 ANN in Engineering
CE-1482 Evolutionary Algorithm in Search and Optimization
CE-1483 Finite Elements Methods in Engineering

CE 1101 **ENGINEERING GRAPHICS** **L-T-P-C**

Pre-requisite: None **1-0-3-5**

Semester: 1

Introduction: Introduction to Engineering Graphics. General instruction regarding instruments, lettering, type of lines

Geometric constructions: Division of lines, angles and curves. Construction of different polygons

Scales: Construction and reading of plain, diagonal, vernier and comparative scales.

Conic sections: Construction of parabola, ellipse, hyperbola, cycloid, trochoids, epicycloids and hypocycloid.

Orthographic projection: Angles of projections, Projection of points in different angles, projection of straight lines, Projection of plane and solid in different positions, Conversion of pictorial views of different types of simple objects into orthographic projections.

Isometric projection: Isometric projection and isometric views of different planes and solids**.**

Introduction to Auto-CAD: Introduction to Auto-CAD software, drawing of different two-dimensional and three-dimensional objects.

Suggested Reading

1. Engineering Drawing, N.D.Bhatt & V.M.Panchal, Rupalee Publication, New Delhi.
2. Engineering Drawing and Graphics+ AutoCAD, K. Venugopal, New Age International, New Delhi.

CE 1201 **BUILDING MATERIALS AND CONSTRUCTION** **L-T-P-C**

Pre-requisite: None **3- 1- 0- 8**

Semester: 3

Building and its Types: Principles of planning – Orientation, Functional requirements, Building Bye-Laws, Dead and Imposed loads. Types of foundation and their suitability. Bonds in Brick work, Rubble and Ashlar masonry, cavity wall, lintels, arches, corbels and. cornices.

Floors and Roofs: Construction details of timber, Jack arch, cement concrete, RCC, Ribbed floor, precast, Marble, Terrazzo and mosaic floors. Roofing and roof covering, exclusion of water, roof terracing, types of roof trusses.

Stair Case: Types, Planning of stair.

Doors and Windows: Types, construction details, fixing ventilators.

Misc: Damp proofing, Termite proofing, Classification and properties of Bricks, testing of bricks. Mechanical properties, seasoning and preservation of Timbers. Desirable properties, types, constituents of Paints.

Suggested Reading

1. Building Construction, B.C. Punmia, *Laxmi Publication*.
2. Element of Building Construction, S.C. Rangwala, *Charotar Publication, Pune*.
3. A Text Book of Building Construction, S.K. Sharma, *S. Chand Publication, Roorkee.*
4. Engineering Materials, S.C. Rangwala, *Charotar Publication, Pune*.
5. Building Planning, Design and Scheduling, Gurucharan Singh. Standard Publication Distributor, Delhi.
6. Building Bye Laws, *Silchar Development Authority*.
7. NBC, BIS, New Delhi.
8. IS 875, BIS, New Delhi.

CE 1202 **SURVEYING** **L-T-P-C**

Pre-requisite: None **3- 1- 0- 8**

Semester: 3

Principles of Surveying, Types of surveying, Chain and compass survey, Theodolite Traversing, Accuracy and errors, Triangulation, Leveling, Reciprocal leveling, Trigonometrical leveling, Contouring , Area and volume computation, Plane Table surveying , Setting out of Simple works, Tacheometric survey, Curves, Electronic Distance Measurement (EDM), Total Station and GPS, Introduction to Photogrammetry and Remote sensing.

Suggested Reading:

1. Surveying (Vol I & II), B.C. Punmia, *Laxmi Publication, New Delhi.*
2. Surveying (Vol-I & Vol-II), K. R.Arora, *Standard Book House*.
3. Surveying & Leveling (Vol-I & Vol-II), T. P. Karnatkar, *Pune Vidyarthi Prakashan*.
4. Engineering Surveying, G.W. Scholfield, Butterworth, Heinemann, *New Delhi*.

CE 1203 **STRENGTH OF MATERIALS** **L-T-P-C**

Pre-requisite: Engineering Mechanics (ME-1101) **3- 1- 0- 8**

Semester: 3

Simple stresses and Strains: Stress, strain, type of stresses, elastic limit, Hooke's law, stress-strain curve, factor of safety, elastic constants, initial stiffness and secant stiffness, elongation of bars of varying sections, elongation of bars of composite sections, elongation due to self weight, bars of uniform strength, complementary shear stresses.

Bending moments and Shear forces: Beam – elastic curve, type of loads, type of supports, SF and BM, sign convention, SF and BM diagrams for cantilever, simple supported and overhanging beams, relationship between rate of loading, SF and BM.

Deflection of beams: Relationship amongst curvature, slope and deflections, slope and deflection for cantilever and simply supported beams, Macaulay's method.

Stresses in beams: Theory of bending, neutral axis and moment of resistance, bending stresses in symmetrical sections, section modulus, composite beams, shear stresses in beams.

Compound stresses: Stresses on inclined plane, stresses on inclined plane due to bi-axial normal stresses and shear stresses, principal plane, principal stresses and strains. Mohr's circle of stress.

Torsion: Analysis of torsional stresses in a plain circular shaft, power transmitted, combined bending and torsion, equivalent bending moment and torsion.

Combined Bending and Direct Stresses: Resultant stresses for rectangular and circular columns due to eccentric loads, limit of eccentricity for no tension, middle third rule.

Thin Shells: Thin cylindrical and spherical shells - Hoop stress and strain, volumetric changes.

Columns and Struts: Short and long columns, Failure of columns, slenderness ratio, Euler's theory, crippling load, Rankine's formula, Straight line and parabolic formula.

Mechanical Properties: Definitions of different properties and description of experiments for their determination.

Suggested Reading:

1. Strength of Materials, G.H.Ryder, *ELBS & Macmilan*.
2. Mechanics of Materials, Pytel and Singer, *Harper Collins Publications India Pvt. Ltd., New Delhi*.
3. Strength of Materials, U.C. Jindal, Umesh Publications, New Delhi.
4. Mechanics of Materials, Beer and Johnston, Tata McGraw-Hill, New Delhi.

CE 1204 **ENGINEERING GEOLOGY** **L-T-P-C**

Pre-requisite: None **3- 0- 0- 6**

Semester: 3

Origin, age and interior of the earth, Crystallography, Mineralogy, Physical Geology, Petrology of igneous, sedimentary and metamorphic rocks, Structural Geology, Seismology, Exploration geology, Ground water, Indian stratigraphy, Economic geology.

Suggested Reading:

1. A text Book of Geology, P.K.Mukhacharjee, World Press Pvt Ltd., Kolkata.
2. Engineering Geology, Parbin Singh, S.K. Kataria & Sos, New Delhi.
3. Engineering Geology, Kesavulu, Mc Millan India Ltd. Delhi.
4. Text book of Mineralogy, Dana. Wiley Eastern Ltd., New Delhi.

CE 1211 **SURVEYING LAB** **L-T-P-C**

Pre-requisite: Surveying Theory (CE 1202) **0- 0- 2- 2**

Semester: 3

List of Experiments:

1. Chain survey by perpendiculars offsets.
2. Chain survey by oblique offsets.
3. Open and closed traverse survey with chain prismatic compass.
4. Plane table survey by methods of radiation, intersection, resection.
5. Profile leveling with dumpy level, cross sections, reciprocal leveling, contouring.
6. Surveying with Theodolite – vertical and horizontal angles.

7. Use of total station.

CE 1205 **STRUCTURAL ANALYSIS-I** **L-T-P-C**

Pre-requisite: Strength of Material (CE 1203) **3- 1- 0- 8**

Semester: 4

Introduction to Structural Analysis: Difference between determinate and indeterminate structures, degree of indeterminacy, open tree concept, forms of structures, loads and forces, different types of supports, basic equilibrium equations, principle of superposition.
Statically Determinate Beams: Different types of beams, axial thrust, bending moment, torsion and shear force in beams with concentrated load and distributed loads.
Deflection and slope in beams: Computation of slope and deflection by double integration method, moment area method and conjugate beam method for simply supported, hinged, cantilever and overhang beams with prismatic and non-prismatic sections.
Strain energy and virtual work: Computation of strain energy for axial force, bending moment, shear force and torsion. Castigliano's theorems and their applications to find deflection and redundant forces in simple cases.
Analysis of pin joined structures: Different types of trusses, redundancy of trusses, method of joints, graphical method, deflection of joints, truss with single redundancy, Maxwell's reciprocal theorem, Betti's theorem and their applications.
Arches and Cables: Detailed analysis of three hinge arches, introduction to two hinge arches, cables, three hinged stiffening girder.
Columns and struts: Euler's theory of buckling, load carrying capacity of column under different support condition, eccentrically loaded column.

Suggested Reading:

1. Theory of Structural Analysis, Timoshenko and Young, *Mc.Graw Hill International*.
2. Structures, Marshall and Nelson, *Pritam Publishing,*
3. Structural Analysis, Norris and Wilbur, *Mc.Graw Hill International*.
4. Basic Structural Analysis, C S Reddy, *Tata Mc.Graw Hill, New Delhi.*
5. Analysis of Structures, V.N. Vazirani and M M Ratwani, *Khanna Publishers, New Delhi.*

CE 1206 **HYDRAULICS** **L-T-P-C**

Pre-requisite: Engineering Mechanics (ME-1101) **3- 1- 0- 8**

Semester: 4

Basic Concepts: Continuum Approach, Important physical properties: Density, Specific weight, Viscosity, Surface tension, Capillarity, Compressibility, Vapour pressure, Classification of fluids –ideal and real fluid, non-Newtonian fluids.
Fluid Statics: Pressure at a point-Pascal's Law, pressure variation in a static fluid. Scales of pressure – absolute and gauge pressure, Measurement of pressure-manometers, Forces on submerged plane and curved surfaces, Buoyant Force-centre of buoyancy, metacenter, determination of metacentric height, equilibrium of floating and submerged bodies.
Kinematics of Fluids: Study of fluid motion – Lagrangian and Eulerian methods, Classification of flow-steady and unsteady flow, uniform and non-uniform flow, rotation and irrotational flow, laminar and turbulent flow, 1-,2- & 3D flow, Concepts of streamlines, pathlines and streakline, stream tube, Continuity equation, Circulation, vorticity, Stream function, Velocity potential, Flownet.
Dynamics of fluid flow: Euler's equation of motion, Bernoulli's equation and its application-venturimeter, orificemeter, Pitot tube, momentum equation and its application to simple problems.
Orifice, mouthpiece, Notches and Weirs: Classification, discharge through a free orifice, orifice coefficients-experimental determination, External and internal mouthpiece, mouthpiece running full and free.
Classification, Velocity of Approach, Broad crested weir.
Flow through pipes: Losses in pipes flow-major loss (Loss due to friction) Darcy Weisbach equation, minor losses, Hydraulic gradient lines, Total Energy lines. Pipes in series, pipes in parallel, equivalent pipe, Siphon.
Dimensional Analysis: Dimensional-fundamental and derived qualities, Dimensional homogeneity, Methods of Dimensional analysis-Rayleigh's method and Buckingham's π theorem.
Boundary layer Theory: Boundary layer Theory – its thickness, Momentum equation for boundary layer along a flat plate, Laminar and turbulent boundary layers, Boundary layer separation.
Flow around submerged Bodies: Drag and lift – types of drag, dimensional Analysis of drag and lift, drag on flat plate, sphere and cylinder, Karman trail, circulation, Lift on a cylinder with circulation – Magnus effect.

Suggested Reading:

1. Fluid Mechanics, John F. Douglas, Janusz M. Gasiorek and John A. Swaffield, *Pearson Education*.
2. Fluid Mechanics, K.L. Kumar, S. Chand & Co.

3. Fluid Mechanics, Streeter & Wily, Mc Graw Hill.
4. Fluid Mechanics and hydraulic Mechanics, R.K. Bansal, Laxmi Publisher.

CE 1207 **ENVIRONMENTAL ENGINEERING- I** **L-T-P-C**

Pre-requisite: None **3- 0- 0- 6**

Semester: 4

Introduction: Sources of water, Water supply systems.
Water Demand and Quality: Population forecasting, Rate of Demand, Variation in the rate of demand.
Quality of water: Impurities and their effects. Surface and ground water pollution, water quality sampling, examination and standards for physical, chemical and bacteriological parameters.
Collection, Conveyance and Distribution of water: Intakes, Types of pipes, Methods of distributions and supply, Storages and distribution reservoirs, Methods for layout, Pressure requirements, Power requirements of pumps, Design of distribution systems.
Water Treatment: Introduction, Sedimentation, Coagulation and Flocculation, Filtration, Disinfection, Adsorption, Membranes, Water Plant Residual Management.

Suggested Reading:
1. Introduction to Environmental Engineering, Davis & Cornwell, SIE, *McGraw Hill Publication.*
2. Environmental Engineering, Peavy & Raow, *McGraw Hill Publication.*

CE1208 **STRUCTURAL DESIGN- I** **L-T-P-C**

Pre-requisite: Engineering Graphics (CE-1101) & Structural Analysis-I (CE 1205) **3- 1- 0- 8**

Semester: 4

Design philosophies, Limit Sate design, Limit states of strength and serviceability, consideration of durability and fire resistance, partial safety factors, Design for flexure, shear, torsion. Design of compression members, interaction curves. Redistribution of moments. Two way and one way slab. Isolated footing, combined footing. Cantilever retaining wall. Introduction to Working stress method of design.

Suggested Reading:
1. Limit State Design of Reinforced Concrete, P.C. Varghese, *PHI, New Delhi.*
2. Reinforced Concrete Design, S.N. Sinha, *Tata McGraw Hill Pub, New Delhi.*
3. Reinforced Concrete, S.K. Mallick and A.P. Gupta, Oxford and IBH Pub., New Delhi.
4. Reinforced Concrete Design, S.U. Pillai and D. Menon, *Tata McGraw Hill Pub, New Delhi.*
5. Reinforced Concrete - Limit State Design, A.K. Jain, *Nem Chand and Co., Roorkee.*
6. Concrete Structures, V.N. Vazirani and M.M. Ratwani, *Khanna Pub, Delhi*.

CE 1213 **ENGINEERING GEOLOGY LAB** **L-T-P-C**

Pre-requisite: Engineering Geology Theory (CE 1204) **0- 0- 2- 2**

Semester: 4

List of Experiments:
Study of crystal models, Study of mineral hand specimens, Study of hand specimens of igneous, sedimentary and metamorphic rocks, Study of thin sections of rocks and minerals, Study of geological maps.

CE 1212 **HYDRAULICS LAB** **L-T-P-C**

Pre-requisite: Hydraulics Theory (CE 1206) **0- 0- 2- 2**

Semester: 4

List of Experiments:

Study of Bernoulli's theorem, Determination of co-efficient of Orifice, Determination of Metacentric height of vessels, Flow measurement by Venturimeter, Flow measurement by Orificemeter, Study of Force due to Impact of Jet, Flow measurement by Notches and Weirs, Study of Pressure measurement devices, Study of Free and Forced Vortex, Study of Flow Visualisation apparatus, Study of Hydraulic Jump, determination of Viscosity.

CE 1301 **GEOTECHNICAL ENGINEERING** **L-T-P-C**

Pre-requisite: Strength of Materials (CE 1203) & Hydraulics (CE 1206) **3- 1- 0- 8**

Semester: 5

Soil: Origin and types, Identification and classification of soil, Index Properties, phase relationship, consistency, sensitivity, clay mineralogy.

Seepage: Darcy's law of permeability, Determination of co-efficient of permeability, Equivalent permeability of stratified soil, Flow nets- principles, construction and application, effective stress analysis, quick sand condition, piping filtration criteria.

Compaction: Principle of compaction, Light and heavy compaction, field compaction control, factors affecting compaction.

Compressibility and Consolidation: Terzaghi's Theory of One Dimensional Consolidation, Secondary Consolidation, Estimation of Consolidation Settlement.

Shear Strength of Soil: Strength envelope, total and effective stress paths, pore pressure, evaluation of shear strength parameters, direct shear, triaxial shear, vane shear, unconfined compression test.

Lateral Earth Pressure: Earth pressure at rest, active and passive earth pressure, Rankine and Coulomb's earth pressure theories, Graphical Solutions.

Stability of Slope: Stability of infinite slope, stability of finite slope, slope protection.

Suggested Reading:

1. Introduction to Soil Mechanics, BM Das, *Galgotia Publication*.
2. Soil Mechanics and Foundation Engineering, BC Punmia, Dhanpat Rai & Sons.
3. Soil Mechanics, Gopal Ranjan & Rao, Dhanpat Rai & Sons.
4. Soil Mechanics, Whitman and Lambe, John Willey.
5. Soil Mechanics and Foundation Engineering, VNS Murthy, Dhanpat Rai & Sons.

CE 1302 **STRUCTURAL ANALYSIS- II** **L-T-P-C**

Pre-requisite: Structural Analysis-I (CE 1205) **3- 1- 0- 8**

Semester: 5

Redundant Structures: Determination of Static and Kinematic indeterminacy.

Indeterminate beams: Analysis of propped cantilever, fixed and continuous beams; effects of sinking of supports, temperature, use of three moment equation.

Classical displacement method of analysis: Application of slope deflection method, moment distribution method, Kanis method in the analysis of indeterminate beams and building frames.

Classical force method of analysis: Analysis of trusses and rigid frames by consistent deformation method, column analogy method and elastic centre method.

Miscellaneous: Two hinged arches, masonry dams and retaining walls, condition for no tension at base, chimneys, piers and abutments; introduction to fatigue, creep and stress concentration.

Suggested Reading:

1. Basic Structural Analysis, C S Reddy, *Tata Mc.Graw Hill, New Delhi*.
2. Indeterminate Structural Analysis, C K Wang, *Tata Mc.Graw Hill, New Delhi.*
3. Theory of structures – Matrix Approach, G S Pundit, S P Gupta and R Gupta, *Tata Mc.Graw Hill, New Delhi.*
4. Analysis of Structures, Vol. I & II, V N Vazirani and M M Ratwani, *Khanna Publishers, New Delhi.*
5. Structural Analysis, Debdas Menon, *Narosa Publishing House*.

CE 1303 **TRANSPORTATION ENGINEERING- I** **L-T-P-C**

Pre-requisite: Nil **3- 0- 0- 6**

Semester: 5

Introduction, modes and role of transportation system, transportation planning, surveying and alignment, road networking and urban transport planning. Highway materials, soils, aggregates, binders, various tests and their significances. Geometric design of highways, cross sections, sight distance, curves, hill roads. Traffic studies, traffic prediction, traffic controls, intersections, transport facilities. Pavement analysis and design, types of pavements, design factors, design methods, reliability. Relevant IRC and IS codes.

Suggested Reading:

1. Highway Engineering, SK Khanna & CEG Justo, *Nemchand Bros., Roorkee.*
2. Traffic Engg. & Transportation, LR Kaaliyali, *Khanna Publishers , Delhi*.
3. An Introduction to Transportation Engg., William W. Hay, *Toppan Co. Ltd, Tokyo*.
4. Principles of Pavement Design, E.J. Yoder & M.W. Nitterzal, *John willey & sons*.
5. Relevant IRC codes – *IRC, New Delhi*
6. Principles of Transportation Engineering., Chakraborty P. & Das A, *Prentice Hall India Pvt. Ltd., New Delhi*.

CE 1304 **ENVIRONMENTAL ENGINEERING- II** **L-T-P-C**

Pre-requisite: Environmental Engineering-I (CE 1207) **3- 0- 0- 6**

Semester: 5

Introduction: Wastewater treatment systems, Terms and definitions.
Collection and Conveyance of sewage: Sewer systems, Planning and Hydraulic Design of sewers, Dry and wet weather flow, Design procedure, Sewer materials, Crown corrosion.
Wastewater Characteristics: Domestic sewage Characteristics, Physical and chemical parameters, Treatment standards, Municipal wastewater treatment systems, BOD, COD, Decomposition of sewage.
Wastewater Treatment: Unit operation and process, Method of treatment, Preliminary treatment, Primary treatment, Secondary treatment, Trickling filters, Activated sludge process, Miscellaneous Treatment systems, Disinfection, Rural sanitation, Septic tank.
Sludge Treatment and Disposal: Thickening, Digestion, Dewatering.
Suggested Reading:
1. Introduction to Environmental Engineering, Davis & Cornwell, SIE, *McGraw Hill Publication.*
2. Environmental Engineering, Peavy & Raow, *McGraw Hill Publication.*

CE 1311 **ENVIRONMENTAL ENGINEERING LAB** **L-T-P-C**

Pre-requisite: Environmental Engineering-I (CE 1207) **0- 0- 2- 2**

Semester: 5

Sampling and preservation of water and wastewater samples. Examination of water /wastewater for determination of – solids, pH, turbidity, chloride, hardness ,acidity, alkalinity, sulphate, iron, residual chlorine, dissolve oxygen, BOD and COD.

CE 1312 **GEOTECHNICAL ENGINEERING LAB** **L-T-P-C**

Pre-requisite: Geo-Technical Engineering (CE 1301) **0- 0- 2- 2**

Semester: 5

List of Experiments
1. Determination of field density and dry density by Core cutter Method.
2. Determination of field density and dry density by Sand replacement Method.
3. Determination of Specific gravity of soil solid.
4. Determination of Liquid limit and Plastic limit. Demonstration of Shrinkage Limit test.
5. Determination of Gradation of soil by Dry sieve analysis.
6. Determination of Gradation of soil by Hydrometer analysis.
7. Soil classification as per the Indian Standard Soil classification system.
8. Determination of Density Index/Relative density of soil.
9. Determination of Optimum moisture content and maximum dry density by Proctor Compaction Test.
10. California Bearing Ratio test..

CE 1313 **TRANSPORTATION ENGINEERING LAB** **L-T-P-C**

Pre-requisite: Transportation Engineering-I (CE 1303) **0- 0- 2- 2**

Semester: 5

List of Experiments

Test on soils – LL, PL, gradation, CBR test. Test of aggregates – AIV, ACV, LAAV, shape test, Specific Gravity and water absorption test, stripping test. Test on bitumen – penetration test, viscosity test, Ring and Ball test, ductility test, Sp. Gravity test. Job mix formula and Bituminous mix design.

CE 1305 **STRUCTURAL DESIGN- II** **L-T-P-C**

Pre-requisite: Structural Analysis-III (CE 1306) and Structural Design-I (CE 1208) **3- 1- 0- 8**

Semester: 6

Introduction: Types of steel, types of connections, durability, classes of sections, steel sections, types of loads, load combinations, permissible deflection, permissible slenderness ratio, methods of design.
Limit state Design philosophy: characteristic load and strength, partial safety factors for material and load.
Connections: Riveted and welded connections, strength of rivet, eccentric connections. Pitch, gauge, lap joint and butt joint.
Tension member: types of failure, design strength, bolted/riveted and welded system.
Compression members: Column buckling, effective length of columns, permissible stress. Built up columns – laced and battened. Design of slab base and gusseted base.
Flexural members: Design for flexure, shear; torsional flexural buckling. Beams, purlin. Plate girder – section design, design of stiffeners, connections.
Miscellaneous: Design under combined stresses, Roof Trusses, Design for earthquake loads, Fatigue, Introduction to working stress method of design, Durability and fire resistance.

Suggested Reading:

1. Design of Steel Structures, N. Subramanian, *Oxford University Press*.
2. Structural Steel Design, J.E. Bowles, *McGraw Hill, New York.*
3. Design of Steel Structures, A.S. Arya and J.L. Ajmani, *Nem Chand & Sons, Roorkee.*
4. Design of Steel Structures, Ramchandra, *Standard Book House, New Delhi.*
5. Design of Steel Structures, S.K. Duggal, *McGraw Hill, New York.*
6. IS 800-2007, IS-816, SP-38, SP-6(6).

CE 1306 **STRUCTURAL ANALYSIS- III** **L-T-P-C**

Pre-requisite: Structural Analysis- II (CE 1302) **3- 1- 0- 8**

Semester: 6

Analysis of building frames: Substitute frame, approximate method of analysis of building frames subjected to gravity loads and lateral loads, portal method, cantilever method.
Moving loads and influence lines: Construction and uses of influence lines for bending moment, shear force for determinate structures like beams and trusses; three hinge arches, application of Muller Breslau's principle for indeterminate structures.
Matrix method of structural analysis: Introduction to matrix method, flexibility method and stiffness method for beams, plane truss and frames. Definition of Plane stress and plane strain problem.
Plastic methods of structural analysis: Concept of plastic method, shape factor, beam, sway and combined mechanism, plastic moment distribution, deflection at point of collapse, introduction to finite element method.

Suggested Reading:

1. Matrix Method of Structural Analysis, W. Weaver and J.M. Gere, *CBS Publishers, New Delhi*.
2. Basic Structural Analysis, C S Reddy, *Tata Mc.Graw Hill, New Delhi*.
3. Indeterminate Structural Analysis, C.K. Wang, *Tata Mc.Graw Hill, New Delhi.*
4. Theory of Structures, G.S. Pundit, S.P. Gupta and R. Gupta, *Tata Mc.Graw Hill, New Delhi.*
5. Analysis of Structures Vol. I & II, V.N. Vazirani and M.M. Ratwani, *Kanna Publishers, Delhi.*
6. Plastic method of Structural Analysis, B.G. Neal, *Champian and Hall.*

CE 1307 **FOUNDATION ENGINEERING** **L-T-P-C**

Pre-requisite: Geotechnical Engineering (CE 1301) **3- 1- 0- 8**

Semester: 6

Soil Exploration and site investigation, Shallow and Deep foundations, bearing capacity and settlement calculations. Vertical and lateral load capacity of piles, pile load tests, well foundation, Soil dynamics and Machine foundations. Ground improvement techniques for cohesive and cohesionless soils, foundations on expansive soils.

Suggested Reading:

1. Soil Mechanics and Foundation Engg, BC Punmia, *Dhanpat Rai & Sons.*
2. Basic and applied soil Mechanics, Gopal Ranjan & ASR Rao, *New Age Int. Pub.*
3. Soil Mechanics & Foundation Engineering.,VNS Murthy, *Dhanpat Rai & sons*.

CE 1308 **TRANSPORTATION ENGINEERING- II** **L-T-P-C**

Pre-requisite: Transportation Engineering -I (CE 1303) **3- 0- 0- 6**

Semester: 6

Railway Engineering: Introduction, traction, gauges, tracks – components and functions. Cross section, coning of wheels, wear and tear, failures, joints, fittings and fixtures, ballast, sleepers and drainage. Geometric design, alignments, gradients, grade compensation, super-elevation, negative sup-elevation, cant, cant deficiency, negative cant, horizontal curves, transition curves. Points and crossing, signaling and interlocking, station yards.

Airport Engineering: Airport planning, aircraft characteristics and configurations, site selection, zoning laws, imaginary surfaces, approach zones, turning zones. Runway and taxiway, runway length and corrections, geometric elements, exit taxiway, separation clearance, ICAO and FAA specifications. Airport layout, holding apron, hangers, parking, terminals, traffic control, marking, lighting, heliports.

Suggested Reading:

1. A. Text Book of Railway Engg, S. C. Saxena & S. P. Arora, *Dhanpat Rai & sons, New Delhi.*
2. Indian Railway Track, Agarwal M.M., *Sachdeva Press, New Delhi.*
3. Airport Planning & Design, S. K. Khanna, M.G Arora & S. S. Jain, *Nemchand Bros., Roorkee*
4. Planning & Design of Airport, Hernjeff R & Makelvey, *Mc Graw Hill New York.*

CE 1309 **HYDROLOGY AND FLOOD CONTROL** **L-T-P-C**

Pre-requisite: Hydraulics (CE 1206) **3- 0- 0- 6**

Semester: 6

Precipitation – Formation and types, forms; measurement, estimating missing precipitation data, average precipitation over area, depth-area-duration analysis.
Stream Flow – Water stage and its measurements, discharge current meter and current-meter measurements, stage-discharge relations, extension of rating curves.
Runoff - The component of runoff, hydrograph, hydrograph separation, factors affecting runoff, unit hydrograph concept, derivation of unit hydrograph, Estimation of peak discharge by Rational Method, Isochrones synthetic unit hydrograph, Definition if IUF. Design flood.
Groundwater - Aquifers, movement of ground water, discharge of groundwater, equilibrium hydraulics of wells.
Flood Routing - Definition, storage equation, routing in a simple reservoir, routing in gated reservoir, stream flow routing.

Sediment transport – Origin and formation of sediments, stream erosion and deposition, definition of regime of flow, plane bed, ripple and dune regime, transition regime, anti-dune regime, introduction to bed loads, siltation, suspended load and wash load.
Classification rivers on alluvial plains – degrading, aggrading and meandering.
Floor Damage Mitigation – reduction of peak flow, confinement of flow, reduction of peak stage, diversion of floodwater, flood proofing, reduction of flood runoff, temporary evaluation of flood prone, flood insurance.

Suggested Reading:

1.Hydrology, H.M. Raghunath, *New Age International, Delhi.*
2.Hydrology for Engineers, Linsley, Kohlew Paulhors, *McGraw Hill.*
3.Hand Book of Applied Hydrology, V.T. Chow, *McGraw Hill.*
4.Engineering Hydrology, K. Subramanya, *McGraw Hill.*

CE 1314 **CONCRETE LAB** **L-T-P-C**

Pre-requisite: Structural Design-I (CE 1208) **0- 0- 2- 2**

Semester: 6

List of experiments:

1. Experimental determination of workability by slump test, compacting factor test, Vebe test and Flow table test.
2. Grading analysis of coarse and fine aggregates.
3. Determination of specific gravity of coarse and fine aggregates.
4. Determination of water content and water absorption of coarse and fine aggregates – free surface moisture.
5. Determination of Specific gravity, standard consistency, initial and final setting time of cement.
6. Determination of compressive strength of cement.
7. Determination of ACV, flakiness and elongation index of coarse aggregates.
8. Test on self compacting concrete
9. Determination of fineness and soundness of cement.
10 Mix design of Concrete.

CE 1315 **STRUCTURAL ENGINEERING LAB** **L-T-P-C**

Pre-requisite: Structural Design-I (CE 1208) **0- 0- 2- 2**

Semester: 6

Determination of ultimate strength, elongation and proof stress of reinforcing bars. Bend and Re-Bend Test, Nominal Mass of reinforcing bars, NDT Tests (Ultrasonic Pulse Velocity, Rebound Hammer Test etc.), Tensile Strength of MS Pipe & various size of Channel / Angle sections (ISMC / ISA).

CE 1401	**CIVIL ENGINEERING ESTIMATION**	**L-T-P-C**
	Pre-requisite: Engineering Graphics (CE 1101) & Building Materials & Construction (CE 1201)	**3- 0- 0- 6**

Semester: 7

Procedure of Estimating: Methods of Estimating, items of works, long-wall, short wall method of estimate, centre-line method, Types of estimate – preliminary, approximate, plinth area estimate, detailed estimate, revised estimate, supplementary estimate. Building Cost Index, Administrative Approval, Expenditure sanction, Technical sanction, Schedule of rates and Measurement Book.
Estimate of Building: Different items of works as per CPWD/APWD schedule such as earthwork, brickwork, cement-concrete, RCC-floors, roofs, openings, painting, white and colour washing, plastering etc.
RCC Works and structures: Different items of RCC work – RCC, shuttering, measurement of reinforcing bars, standard hooks & bends, Bar-bending schedule, Estimate of RCC beam, slab column, footing and staircase.
Roads & Bridges : Introduction to the different items as per CPWD/APWD schedule, estimate of earthwork of road, estimate of metalled road, estimate of RCC slab culvert, T-beam decking, Pier and well foundation, Pipe Culvert.

Analysis of Rates: Analysis of Rates of Building works – RCC, PCC, Brickwork, Plastering, flooring, colour wash, Distempering, cement painting, woodwork, DPC, Doors & Windows, Roofing.
Specifications: General specifications for building works – RCC, Brickwork, Plastering, Flooring, Painting, white & colour wash, Woodworks, Doors & windows, DPC, terracing, rainwater exclusion, specifications for Roadwork.
Valuations: The mathematics of valuation, valuation of freehold & leasehold properties, Fixation of Rent, Methods of valuation, Investment Method, Comparison Method, Residual Method, reinstatement Method, Contractors Method. Methods of valuation of land-comparative method, abstractive method and belting method.

Suggested Reading

1. Estimating & Costing, M. Chakraborty, *M. Chakraborty, Kolkata*.
2. Estimating & Costing, B.N. Dutta, *Kalyani Publication, Kolkata*.
3. Valuation of Real Properties, S.C. Rangwala, *Charoter Publisher, Pune*.
4. Civil Engineering Contracts & Estimates, B.S. Patil, *Orient-Longman Ltd., New Delhi*.
5. CPWD Specifications Vol-I, II, III, &IV, CPWD, *Jain Book Agency, New Delhi*.
6. CPWD Analysis of Rates, CPWD, *Jain Book Agency, New Delhi*.
7. APWD Schedule of Rates, Assam PWD, *Dispur*.

CE 1402	**IRRIGATION ENGINEERING**	**L-T-P-C**
	Pre-requisite: Hydraulics (CE 1206)	**3- 0- 0- 6**

Semester: 7

Introduction – Definition, necessity, types, advantages and disadvantages of irrigation.
Soil Water-plant Relationship – Soil-water plant relationship, soil-fertility and crop rotation, crop-water relationship, manure and fertilizers for improving soil characteristics, principal crops in India.
Water-requirements of Crops – factors affecting water-requirement of crops, consumptive use of water, determination of irrigation water requirement, command area, delta, duty, base period, relation between delta, duty and base period, Kor depth and Kor period.
Flow Irrigation – (a) Unlined canal-Lacey's theory, design of canal based on silt theory. (b) Lined canal-necessity of lining, selection of lining, types of canal lining and their brief description, design consideration for line canal, maintenance of irrigation canals, Economical considerations of lining a canal.
Water-logging – Definition, adverse effects of water-logging, causes of water-logging, anti-water logging measures, Drainage system design.
Canal Head Works – Definition of diversion works and storage weirs and barrages, general layout and the components of head-words, Application of Khosla's theory of independent variables.
Canal Fall – Necessity and location, types of fall, component of fall, design of fall with hydraulic consideration-vertical drop fall and glacis fall.
Cross Drainage Works – Necessity, types of cross drainage work, selection of suitable type of cross drainage works. Design principles only.

Suggested Reading:

1. Irrigation and Water Power Engineering, B C Punmia, *Standard Publishers*.
2. Irrigation and Hydraulics Structures, S K Garg, *Khanna Publishers*.

3. Principles and Practice of Irrigation Engg, S K Sharma, *S.Chand& Co.*
4. Structures Irrigation Engg., GL Asawa, *Willey.*

CE 1403 **PROJECT-I** **L-T-P-C**

Pre-requisite: Depends on Project taken

Semester: 7 **0- 0- 8- 8**

CE 1404 **FOUNDATION ENGINEERING LAB** **L-T-P-C**

Pre-requisite: Geo-Technical Engineering (CE 1301) and Foundation Engineering (CE 1307) **0- 0- 2- 2**

Semester: 7

List of experiments:

1. Determination of co-efficient of permeability by Constant head method.
2. Determination of co-efficient of permeability by Falling head method.
3. Determination of soil shear strength parameters by Direct shear Test.
4. Determination of soil shear strength parameters by Triaxial compression test.
5. Determination of soil shear strength parameters by Unconfined compression test.
6. Determination of soil shear strength parameters by Laboratory Vane shear test.
7. Determination of co-efficient of consolidation by Consolidometer test.
8. Standard Penetration Test.
9. Plate load test.

CE 1411 **OPEN CHANNEL FLOW** **L-T-P-C**

Pre-requisite: Hydraulics (CE 1206) **3- 0- 0- 6**

Semester: 7 (Deptt. Elective I)

Basic Flow Concepts: Types of channels, Classification of flow, Basic equations, Velocity Distribution- Velocity Coefficients, Vertical Pressure distribution.
Energy and Momentum Principles: Specific energy, Critical flow, Section factor, First hydraulic exponent, computation of critical flow, specific force, Simple channel transition.
Uniform flow in rigid boundary: Shear stress on boundary, velocity distribution in turbulent flow, Chezy's equation, Manning's equation, section factor for uniform flow computation, second hydraulic exponent, computation of uniform flow.
Uniform flow in mobile boundary channels: Incipient motion condition- Sheild's analysis, Regimes of flow, prediction of regimes, Flow resistance
Design of Channel: Rigid boundary channels, non-scouring erodible boundary channels, alluvial channels.
Gradually varied flow: Differential equation of GVF, Classification and analysis of flow profiles, Computation of GVF for parametric and non parametric channels.
Rapidly varied flow: Analysis of hydraulic jump, Flow over weir and spillways, Flow under sluice gate, brink depth.
Unsteady flow: Waves- celerity of small gravity waves, GVUF-Saint Venant's equation, Method of characteristics, RVUF- surges in open channels.

Suggested Reading:

1. Flow in open channel,S. Subramanya, *Tata McGraw Hill, New Delhi.*
2. Open channel Hydraulics, V. T. Chow , *McGraw Hill, New York.*
3. Open channel Hydraulics, R.H French, *McGraw Hill, New York.*
4. Open channel Flow, M.H. Chaudry, *Prentice Hall of India, New Delhi.*
5. Flow through open channel, K. G. Ranga Raju, *Tata McGraw Hill, New Delhi.*

CE 1412 **ADVANCED ENVIRONMENTAL ENGINEERING** **L-T-P-C**

Pre-requisite: Environmental Engineering- II (CE 1304) **3- 0- 0- 6**

Semester: 7 (Deptt. Elective I)

Industrial Wastewater Treatment: Introduction, Methods of treating Industrial Wastewater, Pollution Characteristics of certain typical Indian industries and case study.

Air Pollution: Sources and effects, Atmospheric stability, Dispersion, Plume rise and design of stack height, Air pollution control methods and equipment
Environmental Impact Assessment: EIS, Structure and components of EIA, Methods of EIA, Case study.

Suggested Reading:
1. Introduction to Environmental Engineering by Davis & Cornwell, SIE, McGraw Hill Publication.
2. Environmental Engineering by Peavy & Raow, McGraw Hill Publication.

CE 1413 **TRAFFIC ENGINEERING** **L-T-P-C**

Pre-requisite: Transportation Engineering-I (CE 1303) **3- 0- 0- 6**

Semester: 7 (Deptt. Elective I)

Driver behaviour, traffic information and control systems, traffic studies- volume, speed and delay studies, elements of traffic flow theory, characteristics of uninterrupted traffic, capacity and LOS of Uninterrupted facilities, characteristics of interrupted traffic, traffic characteristic at unsignalised intersections, design of signalized intersections, capacity and LOS of signalized intersections, actuated signal control, signal coordination.

Suggested Reading:
1. Roger P. Roess, William R. McShane & Elena S. Prassas, Traffic Engineering, Prentice Hall, 1990
2. Pignataro L.J., Traffic Engineering- Theory and Practice, Prentice Hall, 1973
3. Khisty and B.K. Lall, Transportation Engineering: An Introduction, Prentice Hall India, 2003
4. Wohl M. and Martin B.V., Traffic System Analysis. McGraw Hill Book Company. 1967
5. P. Chakraborty and A. Das, Principles of Transportation Engineering, Prentice hall of India Pvt. Ltd., 2003
6. D. May, Traffic Flow Fundamentals. Prentice Hall, 1990
7. C.S. Papacostas, Transportation Engineering and Planning, Prentice Hall India, 2001.
8. Highway Capacity Manual (HCM), Transportation Research Board, USA, 2000

CE 1414 **OPTIMIZATION METHODS IN ENGINEERING DESIGN** **L-T-P-C**

Pre-requisite: Advanced Structural Analysis (CE 1421) **3- 0- 0- 6**

Semester: 7 (Dept. Elective I)

Introduction to optimisation – Definitions, classification, overview of topics. Single variable optimisation algorithms – optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimisation techniques.
Multivariable optimisation algorithms – optimality criteria, direct search methods, gradient based methods.
Constrained optimisation algorithms – Kuhn-Tucker conditions, algorithms for solving Non-linear programming problems, LPP
Introduction to **Genetic algorithm**

Suggested Reading:
1. Introduction to Linear and Nonlinear Programming, DG Luenberger, *Addison Wesley*.
2. Non-linear Programming Theory and Algorithms by MS Bazarra, HD Sherali and CM Shetty, *John Wiley & Sons.*
3. Engineering Optimization: Theory and Practice, Singiresu S. Rao, *Wiley.*
4. Optimization for Engineering Design: Algorithms and Examples, Kalyanmay Deb, *PHI*.

CE 1415 **GROUND WATER SYSTEM MANAGEMENT** **L-T-P-C**

Pre-requisite: Hydrology & Flood Control (CE 1309) **3- 0- 0- 6**

Semester: 7 (Dept. Elective I)

Ground Water Resources – Introduction, Overview of groundwater systems, Groundwater modelling
Groundwater Flow Equations- Darcy's law, continuity equation, partially saturated flow, Flow in confined, unconfined and leaky aquifers. Flow Equation - boundary and initial conditions for aquifer systems.
Groundwater Mass Transport equations – Mass transport in saturated and partially saturated systems.
Numerical methods applied to steady and transient groundwater systems. Introduction to optimisation (LPP) methods for Groundwater Management.

Suggested Reading:
1. Ground water Hydrology, DK Todd, *John Wiley & Sons*.

2. Ground water Resource evaluation, WC Wattor, *McGraw Hill*.
3. Ground water Models for Resources Analysis and Management, IEL Kadi, *Lewis Publishers*.

CE 1421 **ADVANCED STRUCTURAL ANALYSIS** **L-T-P-C**

Pre-requisite: Structural Analysis-I, II & III (CE 1205, 1302, 1306) **3- 0- 0- 6**

Semester: 7 (Deptt. Elective II)

Matrix method of Analysis of Structures: Static and kinematics indeterminacy of structures. Review of Matrix algebra. Fundamentals of Flexibility and Stiffness method; analysis of beam, frame and truss using Flexibility and Stiffness Method.
Finite Element Method: Brief introduction to finite element method with its principles for two, three and four nodded elements; Shape function, Beam element problems.
Special Problem: Beam on elastic foundation, analysis of simply supported, propped cantilever and cantilever beam due to dynamic loads, Finite difference method, SDOF and MDOF System (Both damped and Un-damped Case).
Analysis of Special Structures: Analysis and Design of dome, Plate and Shell type structures, Design of circular Slab for concentrated, udl, triangular and parabolic loading, Cable stayed and Suspension bridge, Dynamic Analysis of suspension bridge.

Suggested Reading:
1. Matrix Computer analysis of structures , M.F. Rubinatein, *Prentice Hall.*
2. Pile foundation, R.D. Chellis, *Mc Grew Hill Book Co.*
3. Dynamics of Structures, A.K. Chopra, *Prentice Hall of India*.
4. Advanced R.C. Design, N.K. Raju, *CBS Publication, Delhi*.
5. Theory of Vibration with Application, William Timoshenko, *CBS Publishers*

CE 1422 **REMOTE SENSING AND GIS** **L-T-P-C**

Pre-requisite: Surveying (CE 1202) **3- 0- 0- 6**

Semester: 7 (Dept. Elective II)

Energy sources and radiation principles, Remote sensing system, multi spectral scanner. Thematic map, Return beam, thermal infra Red scanner, side looking Air borne radar, Spectral Pattern Recognition: visual and digital techniques, Data acquisition from ERS, Land-sat, SPOT, sea-sat, IRS. Interpretation of Digital data products for MSS and TM.
GIS: Introduction to Geographic Information system, Data encoding, Data management, Integration of Land sat and MSS Data with other spatial Data; Multi level GIS, Data manipulation- Demonstration of software packages and laboratory works for GIS applications with objectives such as transformation, storage, analysis and modeling of the data elements.

Suggested Reading:
1. Principles of Remote Sensing, A. N. Patel Surendra Singh, *Scientific Pub (India).*
2. Principles of Remote Sensing, Paul Curan, *ELBS/Longman (U.K).*
3. Remote Sensing Digital Image Analysis, J. A. Richards, *Springer-Verlag N-Y.*

CE 1423 **GROUND IMPROVEMENT TECHNIQUES** **L-T-P-C**

Pre-requisite: Geo-Technical Engineering (CE 1301)
and Foundation Engineering (CE 1307) **3- 0- 0- 6**

Semester: 7 (Dept. Elective II)

General Principles, soil stabilization – Cement stabilization, lime stabilization, bitumen stabilization, chemical stabilization, mechanical stabilization. Grouting. Preloading with and without sand drains, stone columns, vibro-compaction, compaction piles, blasting, Soil reinforcement, Geosynthetics, Reinforced earth walls.

Suggested Reading:
1. Foundation Engineering, J. Bowles, *McGraw Hills International.*
2. Principles of Grouting, Shah and Shroft.
3. Designing with Geosynthetics, Koerner
4. Ground Improvement Techniques, Purushothama Raj.

CE 1424 **URBAN TRANSPORTATION SYSTEM PLANNING** **L-T-P-C**

Pre-requisite: Transportation Engineering-I (CE 1303) **3- 0- 0- 6**

Semester: 7 (Dept. Elective II)

History of Transportation system development, Urban Transportation Planning Process, Urban Travel and Transportation Systems Characteristics
Travel Demands Forecasting - trip generation, trip distribution, modal split and trip assignment.
Transport Behaviour of Individuals and Households, Land use/ Transportation systems, Introduction to Transport Economics.
Introduction to Urban Freight Transportation and Urban Mass Transportation Systems.
Suggested Reading:

1. Modelling Transport , J. de D. Ortuzar and L.G. Willumsen, *John Wiley and Sons.*
2. Transportation Engineering – An Introduction , C.J. Khisty and B.K. Lall, , *Prentice Hall of India Pvt. Ltd*..
3. Transportation Engineering and Planning , C.S. Papacostas and P.D. Prevedouros, *Prentice Hall of India Pvt. Ltd*..
4. Principles of Transportation Engineering , P. Chakroborty and A. Das, *Prentice Hall of India Pvt. Ltd.*
5. Principles of Urban Transport Systems Planning , B.G. Hutchinson, *McGraw-Hill Book Co., New York.*
6. Traffic Engineering and Transport Planning , L.R. Kadiyali, , *Khanna Publishers, New Delhi,* 2000.
7. Public Transportation , G. E. Gray and L. A. Hoel, *Prentice Hall, New Jersey*, 1992.

CE 1425 **WATER RESOURCES DEVELOPMENT** **L-T-P-C**

Pre-requisite: Hydrology & Flood Control (CE 1309) **3- 0- 0- 6**

Semester: 7 (Dept. Elective II)

Introduction: Fields of Water Resources Engineering, Purpose of Water Resources Development, classification of Water Resources Development projects, India's water Resources, scenario of water use of India.
Probability concepts in design: Frequency series, recurrence interval, statistical methods of estimating the frequency of rare events, duration curves and synthetic stream flow: Thomas &Yering model.
Reservoirs: Classifications, site investigations, Determination of storage capacity : sequent peak algorithm, mass curve; yield, Reservoir sedimentation : sediment inflow rate, Trap efficiency, density of sediment deposited, useful life of reservoir, control of sediment.
Engineering economics: Social Importance, steps in an Engg. Economy study, selecting an interest rate for an economy study, estimated lives of hydraulic structures.
Introduction to Planning for Water-resources development, Multipurpose water Resources Development.
Benefit - Cost analysis: Project evaluation, benefit-cost measurement, examples.

Suggested Reading:

1. Water Resources Engineering, Linsley & Franzine, *McGraw Hill Ltd, N.Y.*
2. Economics of Water Resources Planning, James and Lee, *Tata McGraw Hill, Pub. Co*.

CE 1431 **CAD IN ENGINEERING** **L-T-P-C**

Pre-requisite: Structural Analysis-I, II & III (CE 1205, 1302, 1306) and Strength of Material (CE 1203) **3- 0- 0- 6**

Semester: 7 (Open Elective- I)

Computer languages and computer graphics. Transformation of objects. Design of RCC beams, slabs, columns, footings. Design of steel beams and columns. Analysis and design of Buildings frame and its components. Review of Auto CAD. Introduction to STAAD Pro, SAP2000, ANSYS, MIDAS, MATLAB software.

Suggested Reading:

1. Computer Aided Design, C.S. Krishnamurthy and S. Rajeev, *Mc Graw Hill Pub.*
2. Procedural Elements for Computer Graphics by D.F. Roger, *Mc Graw Hill Pub.*
3. Matrix Analysis of framed Structures, W. Weaver and J.W. Gere, *CBS Publishers, Delhi.*
4. Limit State Design of Reinforced Concrete, P.C. Varghese, *Prentice Hall of India, New Delhi*.
5. Design of Steel Structures, Ramchandra, *Standard Book House, New Delhi.*

CE 1441 **ELEMENTS OF EARTHQUAKE ENGINEERING** **L-T-P-C**

Pre-requisite: Engineering Geology (CE 1204) and Structural Design-III (CE 1442) **3- 0- 0- 6**

Semester: 8

Elements of Seismology: Causes of earthquakes, faults, folds, plate tectonic features, magnitude, intensity, accelerograms, selection of sites for structures, ground motion characteristics.
SDOF Systems: Concept of damping, Motion of systems – Free undamped , Free damped, Forced. Harmonic excitation, dynamic amplification. Logarithmic decrement.
Non-harmonic loading: Response of systems under non-harmonic loadings – Duhamel's integral. Triangular load, rectangular load, blast loads.
MDOF Systems: Two degree of freedom systems – Vibration absorption, Vibration isolation. Transmissibility of force. Many DOF systems – eigen solutions, characteristic equation, Jacobi's method, Power method, Raleigh's method, Stodola's method.

Time step analysis: Linear and nonlinear response – elstoplastic and bilinear systems.
Response spectrum: concept and construction. Use of response spectrum in structural design.
Earthquake resistant design: Design as per IS 1893. Ductile detailing – study of IS 13920 and IS 4326, SP-6(6).

Suggested Reading:

1. Dynamics of Structures – Theory and Application in Earthquake Engineering., A.K. Chopra, *PHI*.
2. Dynamics of Structures, J.L. Humer, *AA Blakema Publishers, Tokyo*.
3. Dynamics of Structures, R.W. Clough and I. Penzien, *McGraw Hill Int, New Delhi*.
4. Seismic Design of R.C. and Masonry Buildings, T. Paulay and M.J.N. Priestley, *John Wiley & Sons, New York.*
5. Earthquake Resistant Design, G.G. Penelis and A.J. Kappos, E & FN Spon, New York.
6. Earthquake Resistant Design of Structures, P. Agarwal and M. Shrikhande, *PHI.*
7. IS 1893 (Five parts), IS 13920, IS 4326, SP-6(6).

CE 1442 **STRUCTURAL DESIGN- III** **L-T-P-C**

Pre-requisite: Structural Design-II (CE 1305) **3- 0- 0- 6**

Semester: 8

Introduction: Review of Limit State and Working Stress method of design.
Building: Staircase, Lateral load analysis – portal and cantilever method, Transfer of load from slab to beams equivalent load, continuous beams. Substitute Frame method for the Analysis of building frame, Live load on Building. Design for seismic load. Design of circular slab, design of circular and rectangular slab with concentrated load, circular beam; partition wall, Design for Torsional moment for simply supported slab.
Water Tanks And Domes – Circular, rectangular, overhead and underground water tanks – IS code method, Design of spherical dome.
Prestressed Concrete – Concept, IS code requirements (IS: 1343) systems of prestressing, losses, simple design. Concept of Design of end blocks, Magnate and Battens method.
Steel & Timber: Steel Bridges – pedestrian truss bridge. Industrial Building – Trusses, Portal, Knee braces. Timber structures – IS Code requirements, classification of timber, simple design.
Suggested Reading:

1. Advanced Reinforced Concrete Design, N. Krishna Raju, *CBS Publishers and Distributors, Delhi.*
2. Prestressed Concrete, Krishna Raju, *Tata McGraw Hill, New Delhi*
3. Design of Steel Structures, N. Subramanian, *Oxford University Press*.
4. Design of Steel Structures (Vol. I & II), Ram Chandra, *Standard Book House, Delhi.*
5. Masonry & Timber Structures, A.S. Arya, *Nem Chand & Brothers, Roorkee*.
6. Design of Wood Structures, Donald E. Breyer, *Tata McGraw Hill, New Delhi.*

CE 1443 **PROJECT-II** **L-T-P-C**

Pre-requisite: Depends on Project taken **0-0-10-10**

Semester: 8

CE 1451 **CONSTRUCTION MANAGEMENT** **L-T-P-C**

Pre-requisite: Building Material & Constructions (CE 1201) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-III)

Principles of project contracts, types of contract documents, types of contracts, tender & agreements, acceptance of tenders, earnest money & security deposits, breach of contracts and arbitration.
Project Management through network, critical path method, early and late time calculations, Float, resource allocation.
Programme evaluation & Review technique, expected times and slack, critical path, probability of completion time of a project.
Competitive bidding in construction industry, bidding strategy, Freidman's model, Gate's model, Fine's model, effect of estimating inaccuracy, margin lost in competition, effect of estimating accuracy, No. of bidders, success rate sensitivity analysis, Risk analysis & decision trees, Lime of balancing, network compression, Prefabrication, modular co-ordination and standardization.

Concrete production plants, batching, mixing and compaction of concrete, pumping of concrete, curing methods, concreting in hot and cold weather, concreting under water. Guniting and shortcreting , shoring and underpinning, formwork, building bye laws.

Suggested Reading

1. Construction Engineering and Management, S. Seetharaman, *Umesh Publication, 3b Nath Market, Nar Sarak, New Delhi-6.*
2. Construction Equipment its Planning land Application, Mahesh Verma, *Metropolitan Book Co. Ltd., 1, Netaji Subash Marg, New Delhi-2.*
3. Contract and Estimates, B.S. Patil.
4. Construction Equipments & Methods, S. Peurofoy, *McGraw Hill International*.
5. Optimization Theory & Application, S.S. Rao, *Wiley Eastern Ltd., New Delhi.*

CE 1452 **ADVANCED HYDROLOGY** **L-T-P-C**

Pre-requisite: Hydrology & Flood Control (CE 1309) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-III)

Hydrologic processes – Hydrologic cycle, systems concept, system models and its classification, Reynolds Transport Theorem, continuity equation, momentum equation.
Atmospheric circulation, water vapor, precipitation, Thunderstorm cell model, evaporation and evapo-transpiration. Unsaturated flow, infiltration, Green-Ampt method, pounding time. Stream flow hydrograph, stream networks.
Analysis of discrete and continuous hydrologic data. Harmonic analysis, statistical analysis including frequency analysis, correlation and regression analysis. Time series analysis and its application in hydrology.
Linear, nonlinear, lumped and distributed parameter systems. Hydrologic design of water resources systems.

Suggested Reading:

1. Hydrology, H.M. Raghunath, *New Age International, Delhi*.
2. Hydrology for Engineers, Linsley, KohlewPaulhors, *McGraw Hill.*
3. Hand Book of Applied Hydrology , V.T. Chow, *McGraw Hill*.
4. Engineering Hydrology, K subramanya, *McGraw Hill*.

CE 1453 **ADVANCED FOUNDATION ENGINEERING** **L-T-P-C**

Pre-requisite: Foundation Engineering (CE 1307) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-III)

Soil Exploration, report writing, geophysical investigations. Design of combined footing, strip footing, strap footing, footings on layered soils, uplift load. Rafts and floating rafts. Pile foundations, negative skin friction, Group capacity, settlement of pile group, uplift force, Laterally loaded piles Sheet piles, design of cantilever sheet

piles and anchored bulkheads, methods of reducing lateral pressure. Soil Dynamics, Barkan's methods, elastic halt space theories, vibration isolation. Ground improvement methods.

Suggested Reading:

1. Foundation Engineering, S P Brahma, *Tata Mc Graw Hills, NewDelhi.*
2. Foundation Engineering, J. Bowles, *Mc Graw Hills International*.
3. Designing with Geosynthetrcs, Koerner
4. Soil Dynamics, Barkan
5. Hand book of Machine foundation, Srinivasulu, *Tata McGraw Hills, New Delhi.*

CE 1454 **BRIDGE ENGINEERING** **L-T-P-C**

Pre-requisite: Structural Analysis- III (CE 1306) and Structural Design- III (CE1442) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-III)

Introduction: Introduction to bridge engineering, types of bridges, basics design criteria of bridge engineering, seismic effect on bridges, ground response Analysis at the bridge site, IRC loading, MOST specifications for the guide line of design of minor bridges. Geotechnical aspects of bridge location and suitability of girder depending on the span of the bridge.

Pre-Stress Bridge: Introduction to Pre-stress Bridges, Pre-stress T-beam type bridge, Pre-stress Box-type Bridge, Losses of Pre-Stress of Bridges, Torsional Analysis of bridges, Transverse and Longitudinal Analysis.

Reinforced Concrete Bridge: RCC T-beam beam bridge, Box-type bridge, Solid Slab bridge, Skew type bridge, Cable and Suspension type bridge.

Foundation of Bridges: Different type of foundation of bridges, open foundation, Pile foundation and well foundation, Design of Abutment Shaft, Pier Shaft, Well Cap, Abutment Pile Cap, Design aspects of Pier Shaft Cap and Abutment Shaft Cap.

Dynamic Analysis of Bridges: Introduction to Dynamic analysis of bridges, Eigen value and mode shape of simply supported bridges.

Suggested Reading:

1. A Text Book of Bridge Engineering, K.S. Rakshit, *Oxford & IBH Publishing Co.*
2. Essentials of Bridge Engineering, Johson Victor, *Oxford & IBH Pub. Co.*
3. Design, Construction & Practice in Bridge Engineering, S. Ponnaswamy, *Tata McGraw Hill Pub., New Delhi.*
4. Theory of Vibration with Application, William Timoshenko, *CBS Publishers.*

CE 1455 **ANALYSIS AND DESIGN OF PAVEMENTS** **L-T-P-C**

Pre-requisite: Transportation Engineering-I (CE 1303) & Geo-Technical Engineering (CE 1301) and Structural Design- I & III (CE 1208, 1442) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-III)

Philosophy of design of flexible and rigid pavements, analysis of pavements using different analytical methods, selection of pavement design input parameters – traffic loading and volume, material characterization, drainage, failure criteria, reliability, design of flexible and rigid pavements using different methods, comparison of different pavement design approaches, design of overlays and drainage system.

Suggested Reading:

1. Principles of Pavement Design, E.J. Yoder, *John Willey & Sons Ive, New York.*
2. Principles of Transportation Engg. , P. Chakraborty & A Das, *PHI Pvt. Ltd., New Delhi*.
3. Highway Engg By Khanna S. K. And Justo C.E.G., *Nemchand Bros., Roorkee.*
4. Pavement Analysis & Design By Huang Y. H., *Pearson Education Inc., NJ., USA*.
5. All relevant IS & IRC Codes and NORTH Guidelines

CE 1456 **DESIGN OF SPECIAL STRUCTUES** **L-T-P-C**

Pre-requisite: Structural Analysis-I, II, III (CE 1205, 1302, 1306) and Structural Design- I, II, III (CE 1208, 1305, 1442) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-III)

Design of – Chimneys, Bunkers, Silos, Folded plates, Shells, Domes, Buried Pipes, Tubular Frame Buildings, RC Walls, Frame-wall system, Elevated Water tanks with dynamic effects. Frame-wall interaction, Shear Lag effect in buildings.

Suggested Reading:

1. Reinforced Concrete Design of Tall Buildings, B.S. Taranath, *CRC Press, New York.*
2. Advanced Reinforced Concrete Design, N. Krishna Raju, CBS Pub. & Distr., Delhi.
3. Advanced Reinforced Concrete Design, P.C. Varghese, *PHI, New Delhi.*
4. Reinforced Concrete, S.K. Mallick and A.P. Gupta, Oxford and IBH Pub., New Delhi.
5. Reinforced Concrete Design, S.U. Pillai and D. Menon, *Tata McGraw Hill Pub, New Delhi.*

CE 1461 **HYDRAULIC STRUCTURES** **L-T-P-C**

Pre-requisite: Open Channel Flow (CE 1411) & Irrigation Engineering (CE 1402) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-IV)

Dams and their Characteristics: Classification of dams, features, advantages and disadvantages of each type, Selection of type of dam.
Investigation of dam sites: Various phases of investigation, geological investigation, Sub-surface exploration, choice of location, Foundation treatment, Economic height of dam.
River diversion: Diversion schemes, Phases of diversion, diversion flood, tunnels, Cofferdams.

Gravity dams: Forces acting on gravity dams, load combinations for design, models of failure and stability requirements, Structural competency of gravity dams, Practical profile, Stability analysis, Design of non-overflow and overflow sections by single-step method.
Arch dams: Types of arch dams, Forces acting on each arch dam, Method of analysis, most economical central angle, Design of each dams based on cylinder theory.
Embankment dams: Types of embankment dams, earth dams-types, causes of failure and stability requirements, Design criteria, Preliminary design, Seepage analysis-Flownet, Phreatic line, stability analysis-Safety of u/s slope against rapid draw-down, Safety of d/s slope against steady seepage.
Hollow and Buttress dams: Hollow gravity dams, Buttress dams- types of buttress dams, Forces acting on buttress dams Design of deck-slab type buttress dams.
Weirs and Barrages: Types of weirs, causes of failure, Design of weirs on permeable foundation, Bligh s creep theory, Khoslas theory-method of independent variables.
Instrumentation: Instrumentation in dams, types of Instruments, deformation measurement of dam body and its foundation, surveying instruments.

Suggested Reading:

1. Irrigation and Water Power Engineering, BC Punmia and Pande B.B. Lal, *Laxmi Publications.*
2. Irrigation Water Power Engineering and Water Resources Engineering, K.R. Aurora, *Standard Pub*.

CE 1462 **ELEMENTARY PERFORMANCE-BASED SEISMIC DESIGN** **L-T-P-C**

Pre-requisite: Elements of Earthquake Engineering (CE 1441) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-IV)

Historical development of Design philosophies. Force-Based Design vs. Performance-Based Design. Limitations of Force-Based Method of Design. Limitations of IS 1893 (Part 1) – 2002. Moment-curvature relationship. Strength and stiffness relationship
Definition of Maximum earthquake and Design Basis earthquakes. Spectrum Compatible ground motion. Response spectrum review. Displacement spectra
The concept of Capacity design. Expected strength and extreme strength of materials.
Performance levels – Immediate Occupancy Level, Life Safety Level, Collapse Prevention Level. The concept of Operational Level building and Life Safety Building.
Displacement-Based design philosophies. Direct displacement-Based Design Methods. Drift in buildings and design for drift. Frame Buildings, Frame-wall buildings, Design for target performance objectives. Effect of Infill on building behaviour.

Suggested Reading

1. Displacement-Based Seismic Design of structures, M.J.N. Priestley, G.M. Calve and M.J. Kowalsky, 2007, *IUSS Press, Pravia*.
2. Seismic Design of Frame-Wall Structures, T.J. Sullivan, M.J.N. Priestley and G.M. Calvi, *Research Report No. ROSE-2006/02*.
3. Seismic Design of Reinforced Concrete and Masonry Buildings, T. Paulay and M.J.N. Priestley, *John Wiley & Sons, New York.*

4. Earthquake Engineering: From Engineering Seismology to Performance-Based Engineering, Editor Y. Bozorognia, *CRC Press*.
5. ___ ATC-40, Applied Technology Council.
6. ___ FEMA 273, NEHRP.
7. ___ FEMA-356, NEHRP.
8. ___ FEMA-440, NEHRP.
9. ___ FEMA-450, NEHRP.

CE 1463 **CONRETE TECHNOLOGY** **L-T-P-C**

Pre-requisite: Building Materials and Constructions (CE 1202) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-IV)

Cement and Admixtures: Types of Portland cement, hydration, setting and hardening process, special hydraulic cements, Admixtures, accelerators, and retarders, air-entraining agents, plasticizer and super-plasticizers.
Aggregates: Shape and texture, bond, strength, specific gravity, bulk-density and moisture content of aggregates, bulking of sand, deleterious substances in aggregates, alkali-aggregate reaction, sieve-analysis and grading curves, fineness modulus, practical grading, gap grades aggregates.

Fresh Concrete: Rheological aspects such as workability-flow ability, compatibility and mobility of concrete, factors affecting workability and lab determination, segregation, bleeding & laitance.
Strength of Concrete: Compressive strength and factors affecting it, behaviours or concrete under various stress states, testing of hardened concrete – cube and cylinder test, Platen effect, flexure test, non-destructive testing such as rebound hammer test, USPV test, core-cutting, stress-strain relation and modulus of elasticity, shrinkage, creep of concrete and its effect.
Durability of Concrete: Corrosion of reinforcing bars, sulphate attack, frost action, deterioration by fire, concrete in seawater, acid attack, carbonation.
Concrete Mix Design: Basic consideration – cost, workability, strength and durability, grading, method of mix design, acceptance criteria for concrete.
Advances in Construction Materials: Higher strength concrete, fibre-reinforced concrete, concrete containing polymers, heavy weight and light weight concrete, mass concrete, blended concrete, Ferro-cements and its applications.

Suggested Reading:

1. Concrete, Structure, Properties and Materials by P.K. Mehta, *Prentices-Hall, Inc., New Jersy, USA.*
2. Properties of Concrete, A.M. Neville, *Longman U.K.*
3. Concrete Technology, M.L. Gambhir , *Tata McGraw Hill*.
4. Testing of Concrete in Structures, J.H. Bungey, *Surrey University Press, New York.*
5. Polymers in Civil Engineering, L. Hollaway, *Thomas Telford Ltd., London*.
6. Special Techniques and Materials for Concrete, Dhir, *Thomas Telford Ltd., London.*

CE 1464 **NUMERICAL METHODS** **L-T-P-C**

Pre-requisite: Mathematics-III (MA 1201) and Structural Analysis-III (CE 1306) **3- 0- 0- 6**

Semester: 8 (Deptt. Elective-IV)

Nonlinear system of equations, Curve fitting techniques, numerical differentiation and integration, Numerical solution of ordinary and partial differential equations, Introduction to finite difference methods, Application of numerical methods in solving Engineering Problems.
Basics of computer algorithms and flow charts, Introduction to application of high level computer programming in solving numerical problems.

Suggested Reading:

1. Numerical Mathematical Analysis, J.B. Scarborough, Oxford & IBH Pub. Co. Pvt. Ltd., Kolkata.
2. Numerical Methods for Engineers, S.C. Chapra and R.P. Canale, Tata McGraw-Hill., New Delhi.

CE 1481 **ANN IN ENGINEERING** **L-T-P-C**

Pre-requisite: Evolutionary Algorithm in Search and Optimization (CE 1482) **3- 0- 0- 6**

Semester: 8 (Open Elective-II)

Introduction to Artificial Neural Network- Concept and issues, Multi layer Network, auto associative and hetero associative nets, Learning in Neural nets, supervised and unsupervised learning, Applications of ANN, ANN simulators

Suggested Reading:

1. Fundamentals of Neural Networks, Faussett, *Prentice Hall.*
2. An Introduction to Neural Networks, J.A Anderson, *MIT Press, Cambridge*.

CE 1482 **EVOLUTIONARY ALGORITHM IN SEARCH AND OPTIMIZATION** **L-T-P-C**

Pre-requisite: Optimization Methods in Engineering Design (CE 1414) **3- 0- 0- 6**

Semester: 8 (Open Elective-II)

Traditional optimisation methods. Foundations of Genetics Algorithms – reproduction, crossover and mutation. Analysis of GA operators – mathematical foundations. Application of Genetic algorithms in Engineering, Concept Multi-objective optimisation - Engineering applications. Introduction to some other evolutionary algorithms.

Suggested Reading:

1. Genetic Algorithms in Search, Optimisation and Machine Learning, DE Goldberg, *Addison Wesley.*
2. Introduction to Evolutionary Algorithms, Xinjie Yu, Mitsuo Gen, *Springer*.
3. Engineering Optimization: Theory and Practice by Singiresu S. Rao, *Wiley.*
4. Optimization for Engineering Design: Algorithms and Examples, Kalyanmay Deb, *PHI.*

CE 1483 **FINITE ELEMENTS METHODS IN ENGINEERING** **L-T-P-C**

Pre-requisite: Advanced Structural Analysis (CE 1421) **3- 0- 0- 6**

Semester: 8 (Open Elective-II)

Basic theory, advantages and disadvantages, convergence criteria, principle of virtual work, energy principles, variational formulations, weighted residual methods. Displacement models, shape functions, element stresses and strains, element stiffness matrix. One dimensional problems, bar elements. Two dimensional elements, triangular elements, quadrilateral elements, higher order elements, Axisymmetic elements. Pin joined trusses, beams, frames, plates. Practical problems.

Suggested Reading:

1. Introduction to finite elements in Engineering, T. K. Chandraputla and A.D. Belegundu, *Prentice Hall of India Pvt. Ltd.*
2. Finite Element analysis (Theory & Programming), C.S. Krishnamurthy, *Tata McGraw Hill Publishing Co. Ltd.*
3. Finite Element methods, K.S. Bathe and E.L. Wilson, *Prentice Hall of India*.
4. Finite Element methods in Engineering Sciences, O.C. Zeinkiewicz, *McGraw Hill Book Co*.

Course Structure for CSE, BTech (4-Year, 8 Semester Course) Computer Science & Engineering

(to be applicable from 2012 batch onwards)

Course No	Course Name	L	T	P	C		Course No	Course Name	L	T	P	C
Semester-1							**Semester-2**					
CH-1101 /PH-1101	Chemistry/Physics	3	1	0	8		EC-1101	Basic Electronics	3	0	0	6
EE-1101	Basic Electrical Engineering	3	0	0	6		CS-1101	Introduction to Computing	3	0	0	6
MA-1101	Mathematics-I	3	1	0	8		MA-1102	Mathematics-II	3	1	0	8
CE-1101	Engineering Graphics	1	0	3	5		ME-1101	Engineering Mechanics	3	1	0	8
HS-1101	Communication Skills	3	0	0	6		PH-1101/ CH-1101	Physics/Chemistry	3	1	0	8
CH-1111 /PH-1111	Chemistry/Physics laboratory	0	0	2	2		CS-1111	Computing Laboratory	0	0	2	2
ME-1111	Workshop	0	0	3	3		EE-1111	Electrical Science Laboratory	0	0	2	2
	Physical Training-I	0	0	2	0		PH-1111/ CH-1111	Physics/Chemistry Laboratory	0	0	2	2
	NCC/NSO/NSS	0	0	2	0			Physical Training –II	0	0	2	0
								NCC/NSO/NSS	0	0	2	0
		13	**2**	**8**	**38**				**15**	**3**	**6**	**42**
Semester-3							**Semester-4**					
EC 1221	Electronic Circuits and Switching	3	0	0	6		CS 1204	Formal Language and Automata Theory	3	1	0	8
CS 1201	Data Structure	3	1	0	8		CS 1205	Signals & Data Communication	3	1	0	8
CS 1202	Object Oriented Design	3	0	0	6		CS 1206	Computer Graphics	3	0	0	6
CS 1203	Discrete Structures	3	1	0	8		HS 1201	Managerial Economics	3	0	0	6
MA 1201	Mathematics-III	3	1	0	8		MA 1251	Mathematics - IV (Introduction to Stochastic Processes)	3	1	0	8
CS 1211	Data Structure Lab	0	0	2	2		CS 1212	Computer Graphics Lab	0	0	2	2
EC 1222	Electronic Circuits and Switching Lab	0	0	2	2		CS 1213	Signals & Data Communication Lab	0	0	2	2
	Physical Training-III	0	0	2	0			Physical Training - IV	0	0	2	0
	NCC/NSO/NSS	0	0	2	0			NCC/NSO/NSS	0	0	2	0
		15	**3**	**4**	**40**				**15**	**3**	**4**	**40**
Semester-5							**Semester-6**					
CS1301	Computer Architecture	3	1	0	8		CS1304	Operating System	3	0	0	6
CS1302	Computer Network	3	0	0	6		CS1305	Compiler Design	3	0	0	6
CS1303	Microprocessor & System Programming	3	1	0	8		CS1306	Design and Analysis of Algorithm	3	1	0	8
MA1351	Mathematics - V (Numerical Methods)	3	1	0	8		CS1307	Database Management System	3	0	0	6
HS-1301	Business Management	3	0	0	6		CS1308	Software Engineering	3	1	0	8
CS1311	Computer Network Lab	0	0	2	2		CS1313	Operating System Lab	0	0	2	2
CS1312	Microprocessor & System Programming Lab	0	0	2	2		CS1314	Database Management System Lab	0	0	2	2
		15	**3**	**4**	**40**		CS1315	Compiler Lab	0	0	2	2
									15	**2**	**6**	**40**
Semester-7							**Semester-8**					
CS 1401	VLSI Design	3	0	0	6		CS1404	Advanced Computer Architecture	3	0	0	6
CS 1402	Theory of Computation	3	1	0	8		CS1405	Machine Learning	3	0	0	6
CS 14XX	Dept. Elective-I	3	0	0	6		CS14XX	Dept. Elective - III	3	0	0	6
CS 14XY	Dept. Elective-II	3	0	0	6		CS14XY	Dept. Elective - IV	3	0	0	6
XX-1XX	Open Elective-I	3	0	0	6		XX-1XXX	Open Elective - II	3	0	0	6
CS 1490	Project-I	0	0	8	8		CS1491	Project - II	0	0	10	10
		15	**1**	**8**	**40**				**15**	**0**	**10**	**40**

NB: Industrial Training after Sixth Semester for a period of 4-6 weeks as an audit course

EE-1111 will be jointly offered by EE and EC Departments

	Elective-I		**Elective-II**
CS1421	Artificial Intelligence	CS1431	Computational Geometry
CS1422	Digital Image Processing	CS1432	Wireless Networks
CS1423	Applied Graph Theory	CS1433	Information Theory and Coding
CS1424	Mobile AdHoc Network	CS1434	Distributed System
CS1425	Simulation and Modeling	CS1435	Data Mining
CS1426	Human Computer Interaction	CS1436	Natural Language Processing
	Elective-III		**Elective-IV**
CS1441	Programming Language Concepts	CS1451	Introduction to Network Calculus
CS1442	Applied Parallel Programming	CS1452	Logic of Computer Science
CS1443	Pattern Recognition	CS1453	Wireless Sensor Network
CS1444	Cryptography and Security	CS1454	Speech Processing
CS1445	VLSI Design, Test and Verification	CS1455	Formal Methods of System Verification
CS1446	Linux Operating System	CS1456	Network Storage Management
	Open Elective-I		**Open Elective-II**
CS1471	Neural Network	CS1481	Soft Computing Techniques for Non-linear Optimization
CS1472	Time Series Analysis	CS1482	Cloud Computing

CS 1101 **INTRODUCTION TO COMPUTING** **L T P C**
Pre-requisite- NIL. (all branch) **3-0-0-6**
Semester-2

What is a program; Digital computer fundamentals; What is a language; How program executes.
C programming: Data types; Operators; Expressions; Scope resolution and variable types; Control flow structures; Functions; Arrays and pointers; Structures and Unions; Stream data processing.
C++ Programming: Introduction to objects and classes; Object hierarchy; Inheritance; Polymorphism; Operator overloading; Templates; Virtual class and Friend class.

Texts/Reference:

1. B.S. Gottfried: Programming in C; TMH.
2. B.W. Kernighan and D.M. Ritchie: The C Programming Language; PHI.
3. H. Schildt: C++: The Complete Reference; TMH, 4e.
4. B. Stroustrup: The C++ Programming Language; Addison-Wesley .
5. E. Balagurusamy: Programming in ANSI C; TMH

CS 1111 **COMPUTING LABORATORY** **L T P C**
Semester-2 **0-0-2-2**

Basic arithmetic operations, control statements, functions, arrays and pointers, structures and unions, file handling etc.
Creation of classes and objects, Inheritance, Operator overloading, Polymorphism, Implementation of Virtual class and Friend class.

Texts/Reference:

1. B.S. Gottfried: Programming in C; TMH.
2. B.W. Kernighan and D.M. Ritchie: The C Programming Language; PHI.
3. H. Schildt: C++: The Complete Reference; TMH, 4e.
4. B. Stroustrup: The C++ Programming Language; Addison-Wesley.
5. E. Balagurusamy: Programming in ANSI C; TMH

CS 1201 **DATA STRUCTURE** **L T P C**
Pre-requisite- CS 1101 **3-1-0-8**
Semester-3

Introduction to data types, Data structures and Abstract Data Types (ADT), Complexity analysis of algorithms, Linked list, Stack, Queue and Recursion.
Introduction to trees, Binary tree, BST, AVL trees, B Trees, B+ Trees, Binary search tree, Hashing, Basic concepts of graphs and their representation schemes.
Bubble sort, Selection sort, Insertion sort, Shell sort, Quick sort, Heap sort, Radix sort, Tree searching and graph searching techniques.
Memory management, Storage Allocation, Garbage Collection, Compaction.

Texts/Reference:

1. A.S. Tanenbaum, Y. Langsam and M.J. Augenstein: Data Structures using C/C++; PHI.
2. V. Aho and J.D. Ullman: Data Structure; Addision-Wesley.
3. D.E. Knuth: The Art of Computer Programming (Vol. 1, 2, 3): Addision-Wesley.
4. E. Horowitz and S. Sahni: Fundamentals of Data Structures; Galgotia Pub.
5. N. Wirth: Algorithms, Data Structures, Programs: PHI.

CS 1202 **OBJECT ORIENTED DESIGN** **L T P C**
Pre-requisite- CS 1101 **3-0-0-6**
Semester-3

Software complexity and design approach, Object model evolution and their elements, application of object models
Objects and their relationships, classes and their relationships, interplay of objects and classes, importance of classification and identification, key abstraction and mechanisms Class diagram, object diagram, interaction diagram, module diagram,

process diagram, micro and macro development process Staffing, release management, Reuse, quality assurance and metrics, documentation, risk and benefits of object oriented development.

Texts/Reference:

1. G. Booch, R.A. Maksimchuk, M.W. Engle: Object-Oriented Analysis and Design with Applications; Addison-Wesley.
2. B. Timothy: Introduction to Object-Oriented Programming; Pearson Ed.
3. J. Rumbaugh: Object-oriented modelling and design: Prentice Hall.
4. P. Coad and E. Yourdon: Object-oriented design; Yourdon Press.
5. P. Coad and E. Yourdon: Object-oriented analysis; Yourdon Press.

CS 1203 **DISCRETE STRUCTURE** **L T P C**
Pre-requisite- NIL **3-1-0-8**
Semester-3

Set theory: sets, relations, functions, countability
Logic: formulae, interpretations, methods of proof, soundness and completeness in propositional and predicate logic
Number theory: division algorithm, Euclid's algorithm, fundamental theorem of arithmetic, Chinese remainder theorem, special numbers like Catalan, Fibonacci, harmonic and Stirling
Combinatorics: permutations, combinations, partitions, recurrences, generating functions
Graph Theory: paths, connectivity, subgraphs, isomorphism, trees, complete graphs, bipartite graphs, matchings, colourability, planarity, digraphs
Algebraic Structures: semigroups, groups, subgroups, homomorphisms, rings, integral domains, fields, lattices and boolean algebras.

Texts/Reference:

1. K. H. Rosen: Object- Discrete Mathematics & its Applications; TMH.
2. J. L. Hein: Discrete Structures, Logic, and Computability; Jones and Bartlett.
3. C.L. Liu: Elements of Discrete Mathematics: TMH.
4. R. L. Graham, D. E. Knuth and O. Patashnik: Concrete Mathematics; Addision-Wesley.
5. J. P. Tremblay and R. P. Manohar : Discrete Mathematics with Applications to Computer Science; TMH.
6. N. Deo: Graph Theory; PHI.

CS 1211 **DATA STRUCTURE LAB** **L T P C**
Semester-3 **0-0-2-2**

Lab programs will be assigned by the course coordinator from within the topics covered in theory classes. There shall be minimum of ten (10) programming assignments out of which minimum of five (05) assignments shall be implemented in C++ and minimum of the five (05) assignments shall be implemented in JAVA.

Texts/Reference:

1. A.S. Tanenbaum, Y. Langsam and M.J. Augenstein: Data Structures using C/C++; PHI.
2. V. Aho and J.D. Ullman: Data Structure; Addision-Wesley.
3. D.E. Knuth: The Art of Computer Programming (Vol. 1, 2, 3): Addision-Wesley.
4. E. Horowitz and S. Sahni: Fundamentals of Data Structures; Galgotia Pub.
5. N. Wirth: Algorithms, Data Structures, Programs: PHI.

CS 1204 **FORMAL LANGUAGE AND AUTOMATA THEORY** **L T P C**
Pre-requisite- CS 1201, CS 1203 **3-1-0-8**
Semester-4

Alphabets and Languages, Finite Automata (FA), Deterministic and Non-deterministic FA, FA with ε- move, Two-way FA, FA with output
Regular Expression and regular set, Closure properties, Pumping lemma, Decision algorithms, Myhill-Nerode theorem
Context-free Grammar (CFG), Derivation tree, Simplification, Chomsky Normal Form and Greibach Normal Form, Ambiguity
Push Down Automata (PDA), PDA and Context Free Language (CFL), Properties of CFL, Pumping lemma, Closure properties and decision algorithms.

Texts/Reference:

1. J. E. Hopcroft, R. Motwani and J. D. Ullman: Introduction to Automata Theory, Languages, and Computation; Pearson Ed..
2. H. R. Lewis and C. H. Papadimitriou: Elements of the Theory of Computation; Pearson Ed.
3. J. C. Martin: Introduction to Languages and the Theory of Computation: TMH.
4. M. Sipser: Introduction to the Theory of Computation; Cengage Learning.

CS 1205 **SIGNALS AND DATA COMMUNICATION** **L T P C**
Pre-requisite- MA-1101, MA-1102 **3-1-0-8**
Semester-4

Introduction, Continuous-time and Discrete-time signals, Linear system, System properties
Input-Output modelling using linear differential equations and linear difference equations, Time-Varying systems
Convolution Representation of LTI and discrete and continuous signals, Linear time-varying systems
Signals in terms of frequency components, Fourier transform as limiting form of Fourier series, Properties, Response to sinusoidal, periodic and a periodic inputs, Sampling
Analog modulation and demodulation of signals, Simultaneous transmission of signals, Digital modulation
Analog and digital data transmission, Transmission impairments, Channel capacity
Wired and wireless transmission, Signal encoding techniques, FDM, Synchronous and Sat TDM, ADSL; XDSL
Spread spectrum analysis (FHSS, DSSS, OFDM), Error handling, Introduction X.25, Frame Relay

Texts/Reference:

1. A. V. Oppenheim, A. S. Willsky and A. H. Nawab: Signals and Systems; PHI.
2. A. Das: Digital Communication: Principles and System Modelling; Springer.
3. S. Haykin and B. V. Veen: Signals and Systems; Willey.
4. W. Stallings: Data and Computer Communications; Pearson Ed.
5. R. L. Freeman: Practical Data Communications; Willey.
6. M. S. Roden: Digital and Data Communication Systems; Prentice Hall.
7. A. Ahmad: Data Communication Principles: For Fixed and Wireless Networks; Kluwer.

CS 1206 **COMPUTER GRAPHICS** **L T P C**
Pre-requisite- CS 1201, MA-1101, MA-1102 **3-0-0-6**
Semester-4

Introduction, Input/Output primitives and graphical devices
2D Transformation, translation, rotation, scaling, matrix representations and homogeneous coordinates system, reflection and shear, transformations between coordinate systems, affine transformation, 3D transformations, translation, rotation, scaling etc.
Line, circle and ellipse drawing algorithms, Area filling algorithms
Viewing procedure, 2D Window to Viewport coordinate transformation, Point clipping, Line clipping and Polygon clipping algorithms, Viewport clipping, Depth cueing.
Curves and surfaces, Bezier curves, B-Spline curves, rational B-Spline curves.
Hidden line elimination - Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, Painter's algorithm.
Coloring and shading models, Modeling Light Intensities and sources, Diffuse reflection, Lambert's Cosine Law, Specular Reflection, Halftoning; Color Models - RGB, CMYK

Texts/Reference:

1. D. F. Rogers: Procedural elements of Computer Graphics; TMH.
2. D. Hearn D and M. P. Baker: Computer Graphics with OpenGL; Pearson Ed.
3. J. D. Foley, A. Van Dam, S. K. Feiner and R. L. P. Hughes: Computer Graphics: Principles and Practice; Pearson Ed.
4. D. F. Rogers and J. A. Adams: Mathematical elements for Computer Graphics; TMH.
5. F. S. Hill: Computer Graphics Using OpenGL; PHI.
6. E. Angle: Interactive Computer Graphics: A Top-Down Approach Using OpenGL; Pearson Ed.
7. D. Hearn and M. P. Baker: Computer Graphics (C version); Pearson Ed.

CS 1212 **COMPUTER GRAPHICS LAB** **L T P C**
Semester-4 **0-0-2-2**

Lab programs will be assigned by the course coordinator from within the topics covered in theory classes. There shall be minimum of eight (08) programming assignments using C/C++ with OpenGL.

Texts/Reference:

1. D. Hearn D and M. P. Baker: Computer Graphics with OpenGL; Pearson Ed.

CS 1213 **SIGNALS AND DATA COMMUNICATION LAB** **L T P C**
Semester-4 **0-0-2-2**

Lab assignments using MATLAB:
Lab programs will be assigned by the course coordinator from within the topics covered in theory classes. There shall be minimum of eight (08) programming assignments covering convolution of discrete and continuous time signals, sum of sinusoids in time and frequency domain, convergence of Fourier series, PAM, QAM, FSK etc.

Texts/Reference:

1. M.J. Roberts: Signals and Systems: Analysis Using Transform Methods & MATLAB: MHill.
2. S. T. Karris: Signals and Systems with MATLAB Computing and Simulink Modeling; Orchard.
3. L. Chaparro: Signals and Systems using MATLAB; Academic Press.

CS 1301 **COMPUTER ARCHITECTURE** **L T P C**
Pre-requisite- EC-1101, EC-1221 **3-1-0-8**
Semester-5

Introduction: Generations of architecture, fundamental concepts of design methodologies, basic organization of computer
Processor Design: Basic organization, instruction set, ALU organization, fixed-point and Floating-point arithmetic
Controller Design: Basic concepts, design of hardwired control and micro-programmed control units
Memory Organization: Basic organization, virtual memory, memory hierarchical structure, paging and segmentation concept, memory interleaving, cache & associative memories
Peripheral processing & devices: I/O accessing and data transfer techniques, I/O channel and processor, I/O management

Texts/Reference:

1. D. A. Patterson and J. L. Hennessy: Computer Organization and Design: The Hardware/Software Interface; Elsevier.
2. C. Hamachar, Z. Vranesic and S. Zaky: Computer Organization; TMH.
3. J. P. Hayes: Computer Architecture and Organization; TMH.
4. W. Stallings: Computer Organization and Architecture: Designing for Performance; Pearson Ed.
5. V. P. Heuring and Jordan H. F.: Computer Systems Design and Architecture; Pearson Ed.

CS 1302 **COMPUTER NETWORKS** **L T P C**
Pre-requisite- MA 1201, CS 1205 **3-0-0-6**
Semester-5

Data Link layer: Data Link layer Services, wired/wireless case studies
Network layer: Network layer services, routing principles, Internet protocol (IP), introduction to quality of service (QoS)
Transport layer: Transport layer services, protocols of transport layer
Application layer: Application layer protocols e.g. HTTP, SMTP, DNS
Network Management: Basic concept, SNMP.

Texts/Reference:

1. L. L. Peterson and B. S. Davie: Computer Networks: A Systems Approach; Elsevier India.
2. A. S. Tanenbaum: Computer Network; PHI.
3. J. F. Kurose and K. W. Ross: Computer Networking: A Top-Down Approach; Pearson Ed.
4. W. Stallings: Computer Networking with Internet Protocols; Pearson Ed.
5. D. Comer: Internetworking with TCP/IP, Volume 1; PHI.

CS 1303 **MICROPROCESSORS AND SYSTEM PROGRAMMING** **L T P C**
Pre-requisite- CS 1101, CS 1201 **3-1-0-8**
Semester-5

8086 architecture, Segments, Flags, Instruction set, assembly language programming on 8086 using assembler, Interrupts, Writing interrupt services routines, Debugging programs, 8086 pin functions
80286/386/486 register set, Data types, Overview of instruction set, Memory segmentation with descriptor tables including LDT and GDT, Privilege levels
Basic concepts of assembler and its design procedures
Basic concepts about a loader, different loader schemes, design principles of loader, overview of linker, design principles of linkers

Texts/Reference:

1. D. Hall: Microprocessor & Interfacing; TMH.
2. J. Turley: Advanced 80386 Programming Techniques; TMH.
3. J. Levine: Linkers and Loaders; Morgan Kauffman.
4. R. S. Gaonkar: Microprocessor Architecture, Programming and application with 8085/8080; Wiley Eastern.
5. J. J. Donovan: System Programming; McGraw-Hill.
6. D. M. Dhamdhere: System Programming and Operating Systems; TMH.
7. L. L. Beck: System Software; Addison-Wesley.
8. D. Tabak: Advance Microprocessor; TMH.

CS 1311 **COMPUTER NETWORK LAB** **L T P C**
Semester-5 **0-0-2-2**

Simulation experiments for protocol performance, configuring, testing and measuring network devices and parameters/policies; network management experiments; Exercises in network programming.

Texts/Reference:

1. L. L. Peterson and B. S. Davie: Computer Networks: A Systems Approach; Elsevier India.
2. A. S. Tanenbaum: Computer Network; PHI.
3. J. F. Kurose and K. W. Ross: Computer Networking: A Top-Down Approach; Pearson Ed.
4. W. Stallings: Computer Networking with Internet Protocols; Pearson Ed.
5. D. Comer: Internetworking with TCP/IP, Volume 1; PHI.

CS 1312 **MICROPROCESSOR AND SYSTEM PROGRAMMING LAB** **L T P C**
Semester-5 **0-0-0-2**

Simulation experiments for 8085/8086, Assembly Language Programming for x86 etc.

Texts/Reference:

1. D. Hall: Microprocessor & Interfacing; TMH.
2. J. Turley: Advanced 80386 Programming Techniques; TMH.
3. J. Levine: Linkers and Loaders; Morgan Kauffman.
4. R. S. Gaonkar: Microprocessor Architecture, Programming and application with 8085/8080; Wiley Eastern.
5. J. J. Donovan: System Programming; McGraw-Hill.
6. D. M. Dhamdhere: System Programming and Operating Systems; TMH.
7. L. L. Beck: System Software; Addison-Wesley.
8. D. Tabak: Advance Microprocessor; TMH.

CS 1304 **OPERATING SYSTEM** **L T P C**
Pre-requisite- CS 1201, CS 1301, CS 1303 **3-0-0-6**
Semester-6

Introduction to OS: Process management, Memory management, File system management, System calls
Process management: Scheduling, preemptive/non preemptive, FIFO, shortest job first, shortest remaining job first, round robin, priority, multilevel queues, multilevel feedback queues, Threads

Concurrent processes: Mutual exclusion and Bernstein's conditions, semaphores, critical section, monitors, message passing, case studies: Dining Philosophers' problem, Producer-Consumer problem and disk head scheduler problem.
Memory management: Single user contiguous, fixed partition multiprogramming, fragmentation, relocation, compaction, paging, segmentation, paging and segmentation together; virtual memory, page replacement policies
File systems: Directory organization, data hierarchy, blocking and buffering, file organization, free space management, contiguous and non contiguous allocation, block chaining, index block chaining, block oriented file mapping
Deadlocks: Resource concepts, necessary conditions, resource allocation graph, three strategies of Havender, Bankers algorithm, reduction of resource allocation graph, deadlock recovery
Disk scheduling: operations of disks, FCFS, SSTF, SCAN, C-SCAN, M-STEP SCAN, Eschenbach, rotation optimization, disk caching

Texts/Reference:

1. A. Silberschatz, P. B. Galvin and G. Gagne: Operating system concepts; Wiley.
2. W. Stallings: Operating Systems; Pearson Ed.
3. A. S. Tanenbaum: Modern Operating Systems; PHI.
4. C. Crowley: Operating systems: a Design-oriented approach; TMH.
5. D. M. Dhamdhere: Operating Systems; TMH.

CS 1305 **COMPILER DESIGN** **L T P C**
Pre-requisite- CS 1201, CS 1204, CS 1301 **3-0-0-6**
Semester-6

Introduction: Overview of Language and implementations, Analysis and synthesis model of compilation, Tool based approach to compiler construction, Retargetability and portability, Trends in compiler construction
Lexical Analysis: Basic concept, Design Issues, Implementation issues, building a simple LA, RE/FSA based LA, Lexical error recovery, From REs to lex generator
Syntax Analysis: Basic concept, basic Parsing techniques, Shift-reduced Parser, Operator-Precedence Parser, Predictive Parser, Top-down and Bottom-up parsing, LL(1) grammars, Recursive decent parsers, Predict-predict conflicts and Error-recovery, DFAs and Parsers for LR(0), SLR(1), LR(1), LALR(1)
Semantic Analysis: Basic concept, Syntax-directed definitions, Attribute grammar (Synthesized and Inherited), Evaluation order, Attribute computation for synthesized, inherited and L-attributes of Bottomup compilation, Getting type attributes, Type matching and conversion

Run-time Environment: Symbol Table management, Memory management, Activation record and parameter passing

Intermediate Code Generation: Basic concept, Three-address codes, quadruples and triples, Arithmetic expression and assignment statements, Boolean expression, Control flow and backpatching (Conditional and iterative statements), Method calls, list of statements
Target Code Generation: Registers and runtime data structures, Method invocation and bookkeeping, phases of code improvement, Peephole optimization, Control flow and basic-blocks, Redundancy and data flow analysis

Texts/Reference:

1. A. V. Aho and J. D. Ullman: Principles of Compiler Design; Narosa Pub..
2. A. V. Aho, R. Sethi R and J. D. Ullman: Compilers: Principles, Techniques and Tools; Addison-Wesley.
3. J. P. Tremblay and P. G. Sorenson: The Theory and Practice of Compiler Writing; McGraw-Hill.
4. S. S. Muchnick: Advanced Compiler Design & Implementation; Narosa.
5. J. R. Levine, T. Mason and D. Brown: Lex and Yacc; O'Reilly.

CS 1306 **DESIGN AND ANALYSIS OF ALGORITHMS** **L T P C**
Pre-requisite- CS 1201 **3-1-0-8**
Semester-6

Introduction: Basic concepts about algorithms
Analysis of algorithms: Idea about time and space analysis, concept of loop invariants, importance of sorting algorithms in analysis, analysis of bubble sort, insertion sort, selection sort algorithms

Design of Algorithms: Introduction to different design approaches, concept of divide-and-conquer approach, analysis of merge sort and quick sort algorithm, concept of randomized algorithms, analysis of heap sort and, radix sort algorithms
Dynamic Programming: Basic concept, Matrix chain multiplication, characteristics of dynamic programming, longest common subsequence, binary search trees and optimal binary search trees
Greedy Algorithms: Basic concepts, Huffman coding scheme, Task scheduling problem, Knapsack problem
Graph Algorithms: Bread-first-search and depth-first-search algorithms, Kruskal's and Prim's algorithms, Dijkstra's algorithm, Ford-Fulkerson algorithm

NP-completeness: Basic concepts

Texts/Reference:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein: Introduction to Algorithms; PHI.
2. D. E. Knuth: The Art of Computer Programming (Vol. 1, 2 & 3); Addison-Wesley.
3. V. Aho, J. D. Ulman and J. E. Hopcroft: The Design and Analysis of Computer Algorithms; Addison-Wesley.
4. M. T. Goodrich and R. Tamassia: Algorithm Design: Foundation, Analysis and Internet Examples; Wiley India.

CS 1307 **DATABASE MANAGEMENT SYSTEM** **L T P C**
Pre-requisite- CS 1201, CS 1203, CS 1204 **3-0-0-6**
Semester-6

Introduction: File System vs. DBMS, data models, levels of Data Abstraction
Entity Relationship (ER) Model: Basic concept, features of ER Model, relational algebra and relational calculus
Design: SQL queries, constraints and triggers, functional dependency, decomposition of relational schemes, normalization, 1NF, 2NF, 3NF, BCNF; Multi-valued Dependency and 4NF; Join Dependency and 5NF; Inclusion Dependency, Query Optimization
File Organization: Properties of Indexes, B+ Tree and its application; Hashing
Transaction processing: Concept of Transaction, concurrency control and database consistency, incomplete transaction, serializibility, locking, concurrency control without lock

Texts/Reference:

1. R. Ramakrishnan, J. Gehrke: Database Management Systems; McGraw-Hill.
2. A. Silberschatz, H. F. Korth and S. Sudarshan: Database Management Systems; McGraw-Hill.
3. R. Elmasri and S. B. Navathe: Fundamentals of Database Systems; Addison-Wesley.
4. N. Shah: Database Systems Using Oracle; Pearson Ed./PHI.
5. R. Greenwald, Robert etc.: Oracle Essentials (10g); O'reilly.
6. C. S. Horstmann and G. Cornell: Core Java (Vol. 1 & 2); Pearson Ed.

CS 1308 **SOFTWARE ENGINEERING** **L T P C**
Pre-requisite- CS 1101, CS 1202 **3-1-0-8**
Semester-6

Introduction: Role of Software Engineering, Concept of process
Software Process: Different process models, Waterfall, Prototype, Iterative, TimeBox, Comparison among the models
Requirement Analysis: Basic concepts of requirement analysis and specification, analysis models, specification language, Use Case concept
Software Architecture: Analysis of different architectures (pipe and filter, shared data style, client-server style), comparison of architectures
Project Planning: Overview, Effort Estimation and COCOMO, project scheduling and team structure, risk management, monitoring plan and SCM

Object-Oriented Design: Basic concepts, overview of UML, design methodologies

Detailed Design: Detailed design and verification, different metrics
Coding: Concept of structured programming, coding process, unit testing with Junit, verification approaches, analysis metrics

Testing: Overview, Black-Box and White-Box techniques, testing process, defect analysis and prevention

Texts/Reference:

1. P. Jalote: An integrated approach to software engineering (3rd ed.); Narosa Pub.
2. R. S. Pressman: Software engineering: a practitioners approach; McGraw-Hill.
3. S. Bennett, S. McRobb and R. Farmer: Object-oriented system analysis and design using UML; TMH.
4. H. V. Vliet: Software engineering: Principles and Practice (3rd ed.); Wiley India.
5. D. W. Brown: Introduction to Object-Oriented Analysis; Wiley India.

CS 1313 **OPERATING SYSTEM LAB** **L T P C**
Semester-6 **0-0-2-2**

Simulation of CPU scheduling algorithms, simulation of file allocation strategies, user-level process management, Development of a LINUX kernel module for a character device.

Texts/Reference:

1. A. Silberschatz, P. B. Galvin and G. Gagne: Operating system concepts; Wiley.
2. W. Stallings: Operating Systems; Pearson Ed.
3. A. S. Tanenbaum: Modern Operating Systems; PHI.
4. C. Crowley: Operating systems: a Design-oriented approach; TMH.
5. D. M. Dhamdhere: Operating Systems; TMH.

CS 1314 **DATABASE MANAGEMENT SYSTEM LAB** **L T P C**
Semester-6 **0-0-2-2**

Design of a ER diagram and DFD for a given problem, table creation, updation and manipulation, implementation of concurrency control methods.

Texts/Reference:

1. R. Ramakrishnan, J. Gehrke: Database Management Systems; McGraw-Hill.
2. A. Silberschatz, H. F. Korth and S. Sudarshan: Database Management Systems; McGraw-Hill.
3. R. Elmasri and S. B. Navathe: Fundamentals of Database Systems; Addison-Wesley.
4. N. Shah: Database Systems Using Oracle; Pearson Ed./PHI.
5. R. Greenwald, Robert etc.: Oracle Essentials (10g); O'reilly.
6. C. S. Horstmann and G. Cornell: Core Java (Vol. 1 & 2); Pearson Ed.

CS 1315 **COMPILER LAB** **L T P C**
Semester-6 **0-0-2-2**

Design of a lexical analyzer, implement the lexical analyzer using lexical analyzer generating tools, design of a predictive parser/LALR bottom up parser for a given language, Convertion of BNF rules into yacc form and to write code for generating abstract syntax tree.

Texts/Reference:

1. A. V. Aho and J. D. Ullman: Principles of Compiler Design; Narosa Pub..
2. A. V. Aho, R. Sethi R and J. D. Ullman: Compilers: Principles, Techniques and Tools; Addison-Wesley.
3. J. P. Tremblay and P. G. Sorenson: The Theory and Practice of Compiler Writing; McGraw-Hill.
4. S. S. Muchnick: Advanced Compiler Design & Implementation; Narosa.
5. J. R. Levine, T. Mason and D. Brown: Lex and Yacc; O'Reilly.

CS 1401 **VLSI DESIGN** **L T P C**
Pre-requisite- CS 1201, CS 1306 **3-0-0-6**
Semester-7

Introduction, data structures and basic algorithms, partitioning, top-down approach for placement and routing, performance Issues in circuit Layout, single-layer routing and applications

Texts/Reference:

1. M. Sarrafzadeh and C. K. Wong: An introduction to VLSI physical design; McGraw Hill.
2. N. A. Sherwani: Algorithms for VLSI physical design automation; Springer.
3. A. T. Sherman: VLSI Placement and Routing: The PI Project; Springer.
4. G. W. Zobrist: Routing, Placement, and Partitioning; Intellect Books.

CS 1402 **THEORY OF COMPUTATION** **L T P C**
Pre-requisite- CS 1201, CS 1204, CS 1306 **3-1-0-8**
Semester-7

Computability theory: Fundamental concepts of Turing machine model, computable languages and functions; Turing machine construction technique; Modification of Turing machine and Church's hypothesis; The Problem of Undecidability; Properties of recursive and recursively enumerable languages; Universal Turing Machine; Rice's theorem; Post's correspondence problem and Intractable problems
Complexity theory: Time- and space-bounded Turing machines, reduction and complete problems, oracle machines and the polynomial hierarchy
P and NP problems: Basic concepts, polynomial time and space, understanding the P-class problems, boolean satisfiability, understanding the NP-class problems, polynomial time reduction, introduction to Cook's theorem, Basic concept of NP-Complete problems

Texts/Reference:

1. J. E. Hopcroft and J. D. Ullman: Introduction to Automata Theory, Languages, and Computation; Narosa Pub.
2. H. R. Lewis and C. H. Papadimitriou: Elements of the Theory of Computation; Pearson Ed.
3. J. C. Martin: Introduction to Languages and the Theory of Computation; TMH.
4. M. Sipser: Introduction to the Theory of Computation; PWS Publishing.
5. F. C. Hennie: Introduction to Computability; Addison-Wesley.
6. B. M. Moret: The Theory of Computation; Pearson Ed.

CS 1404 **ADVANCED COMPUTER ARCHITECTURE** **L T P C**
Pre-requisite- CS 1301, CS 1302, CS 1304 **3-0-0-6**
Semester-8

Introduction: Evolution of computer architecture, Flynn's Classification, Types of Parallelism, Performance Metrics, Different Parallel Computer models

Instruction-level parallelism: Basic concept, Dependency Analysis, Partitioning and Scheduling.

Pipeline architecture: Principles & general structures of pipeline, linear & non-linear model, pipelined instruction processing (arithmetic, Boolean, load/store)
Superscalar pipeline architecture: Basic concept, design issues, shelving, register renaming, preserving sequentialities, case studies; VLIW architecture & case studies.
Code scheduling for ILP processors: Issues in processing control transfer instructions, concepts of code scheduling.
Data Parallel architectures: Basic concept, SIMD architecture (design space approach, overview of finegrained & coarse-grained SIMD); Vector architectures (Basic concept, case studies); Concepts of data pipelined and systolic array architectures.

Thread/process-level parallelism: Introduction to MIMD architecture, basic concept of Multi-threaded architecture, design

issues related to shared-memory & distributed-memory MIMD architectures

Texts/Reference:

1. D. Sima, T. Fountain and P. Kacsuk: Advanced Computer Architectures: A Design Space Approach; Pearson Ed.
2. K. Hwang: Advanced Computer Architecture: Parallelism, Scalability, Programmability; TMH.
3. J. P. Shen and M.H. Lipasti: Modern Processor Design: Fundamentals of Superscalar Processors; TMH.
4. J. L. Hennessy and D. Patterson: A Computer Architecture: A Quantitative Approach; Elsevier.
5. H. S. Stone: High performance computer architecture; Addison-Wesley.

CS 1405 **MACHINE LEARNING** **L T P C**
Pre-requisite- CS 1301, CS 1302, CS 1304 **3-0-0-6**
Semester-8

Introduction, Decision Trees, Probability Primer, Bayes Decision Theory, Maximum-likelihood and Bayesian Parameter Estimation, Non-parametric Techniques, Bayes Networks, Optimization Primer, Linear Discriminant Functions, Support Vector Machines, Unsupervised Learning, Semi Supervised Learning, Reinforcement Learning

Texts/Reference:

1. T. M. Mitchell: Machine Learning; McGraw Hill.
2. R. O. Duda, P. E. Hart, D. G. Strok: Pattern Classification; Wiley Interscience.

CS 1421 **ARTIFICIAL INTELLIGENCE** **L T P C**
Pre-requisite- NIL **3-0-0-6**
Semester-7 (Elective I)

Introduction, problems and techniques related to artificial intelligence
Problem spaces and search, state space graph, production systems BFS and DFS
Inroduction to heuristic search, hill climbing, best first search, A* algorithm, admissibility, AND/OR graph – AO*
Predicate logic, rule-based systems, forward vs backward reasoning, non-monotonic reasoning, statistical reasoning, Dempster Shafer theory, Min-Max search, Alpha-Beta cut-offs
Case studies: MYCIN, R1
Programming languages: PROLOG, LISP

Texts/Reference:

1. Rich and Knight: Artificial Intelligence; TMH.
2. N. J. Nilson: Principles of Artificial Intelligence; Narosa.
3. P. Norvig : Paradigms of AI programming; Elsevier.
4. P. Jackson: Introduction to Expert System; Addison-Wesley.

CS 1422 **DIGITAL IMAGE PROCESSING** **L T P C**
Pre-requisite- CS 1205 **3-0-0-6**
Semester-7 (Elective I)

Introduction: Fundamental steps in image processing, digital image representation, image acquisition and storage
Visual Perception: Basic concepts, structure of human eye, image formation in eye, discrimination of brightness and adaptation, sampling and quantization
Image transforms: Convolution and correlation, FFT and inverse FFT, Walse-Hadamard and K-L transforms, single value decomposition
Image enhancement: Fundamental concepts, enhancement by point processing, intensity transform, histogram processing, spatial filtering, smoothening, median, sharpening and derivative filters, enhancement in frequency domain, low-pass and high-pass filtering
Image restoration: Degradation model - continuous and discrete, inverse filtering, removal of blur caused by uniform linear motion
Image segmentation: Edge detection techniques, edge linking and boundary detection, local and global approaches, thresholding, region-oriented segmentation, region growing, split and merge techniques
Image Compression: Lossy and loss-less compression techniques, feature extraction

Texts/Reference:

1. R. C. Gonzalez and R. E. Woods: Digital Image Processing; Addison-Wesley.
2. A. K. Jain: Fundamentals of Digital Image Processing; PHI.
3. B. Chanda, D. D. Majumder: Digital Image Processing and Analysis; PHI.

CS 1423 **APPLIED GRAPH THEORY** **L T P C**
Pre-requisite- CS 1203 **3-0-0-6**
Semester-7 (Elective I)

Introduction to graphs and their representation, finite and infinite graphs, incidence and degree, path
Directed graph, single source shortest path, all pair shortest path, directed acyclic graph, Euler's graphs, Hamiltonian paths and circuits
Basic results of trees, minimum cost spanning tree
Introduction to cut-sets and cut-vertices, connectivity and separability
Basic concepts of vector space of graph, sets with one or two operations, basis vector, circuit and cut-set subspaces, orthogonal vectors and spaces
Matrix representation of graph, incidence matrix, circuit matrix, path matrix, cut-set matrix and adjacency matrix

Texts/Reference:

1. N. Deo: Graph theory with applications to engineering and computer science; PHI.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein: Introduction to Algorithms;PHI.
3. A. Gibbons: Algorithmic graph theory; Cambridge Univ. Press.
4. V.K. Balakrishnan: Schaum's outline of theory and problems of Graph theory; TMH.
5. E. Horowitz and S. Sahni: Fundamentals of Data Structures; Galgotia Pub.
6. J. L. Gross and J. Yellen: Handbook of Graph Theory; CRC Press.

CS 1424 **MOBILE ADHOC NETWORK** **L T P C**
Pre-requisite- CS 1302 **3-0-0-6**
Semester-7(Elective I)

Mobile Ad-Hoc networking with a View of 4G Wireless, Off-the-Shelf Enables of Ad Hoc, IEEE 802.11 in Ad Hoc Networks: Protocols, Performance and Open Issues, Scatternet Formation in Bluetooth Networks , Antenna Beamforming and Power Control for Ad Hoc Networks, Topology Control in Wireless Ad Hoc Networks, Broadcasting and Activity Scheduling in Ad Hoc Networks, Location Discovery, Routing Approaches in Mobile Ad Hoc Networks, Energy-Efficient Communication in Ad Hoc Wireless, Ad Hoc Networks Security, Self-Organized and Cooperative Ad Hoc Networking, Simulation and Modeling of Wireless, Mobile, and Ad Hoc Networks, Modeling Cross-Layering Interaction Using Inverse Optimization
Algorithmic Challenges in Ad Hoc Networks

Texts/Reference:

1. Aggelou and George: Mobile Adhoc Networks; McGraw-Hill.
2. Stefano Basagni (Editor), Marco Conti (Editor), Silvia Giordano (Editor), Ivan Stojmenovi and Cacute (Editor): Mobile Adhoc Networking; Wiley-IEEE Press.

CS 1425 **SIMULATION AND MODELING** **L T P C**
Pre-requisite- MA-1251 **3-0-0-6**
Semester-7 (Elective I)

Introduction to simulation and modelling, application areas, system and system environment, components of system, type of systems, model of a system, types of models and steps in simulation study
Simulation of queuing systems such as single channel and multi channel queue, lead time demand, inventory system, reliability problem, time-shared computer model, job-shop model
Concepts of discrete event simulation, model components, a discrete event system simulation, simulation formalisms, simulation of single channel queue, multi channel queue, inventory system and dump truck problem using event scheduling approach
Use of probability and statistics in simulation, useful statistical model, discrete distribution, continuous distribution, empirical distribution and Poisson process
Characteristics of queueing systems, queueing notations, long run measures of performance of queueing systems, Steady state behavior of Markovian models (M/G/1, M/M/1, M/M/C), overview of finite capacity and finite calling population models, Network of Queues
Properties of random numbers, generation of true and pseudo random numbers, techniques for generating random numbers, hypothesis testing, various tests for uniformity (Kolmogorov-Smirnov and chi-Square) and independence (runs, autocorrelation, gap, poker)

Texts/Reference:

1. N. Deo: System Simulation With Digital Computer; PHI.
2. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim: Theory of Modeling and Simulation; Academic Press.
3. J. Banks, J. S. Carson, B. L Nelson and D. M. Nicol: Discrete Event System Simulation; Pearson Ed.

CS 1426 **HUMAN COMPUTER INTERACTION** **L T P C**
Pre-requisite- NIL . **3-0-0-6**
Semester-7 (Elective I)

Introduction to HCI, a brief history of HCI, user interface design, direct manipulation, cognitive framework of HCI, perception and representation, attention and interface design, memory in interface design, knowledge representation, user modelling, interaction with natural languages, next generation interface, user interface evaluation: heuristic evaluation, evaluation with cognitive models, evaluation with users model-based evaluation

Texts/Reference:

1. W. O Galitz: The essential guide to user interface design; Wiley.
2. B. Shneidermann: Designing the user interface; Pearson Ed.
3. A. Dix, J. Finlay, G. Abowd and R. Beale: Human – Computer Interaction; Prentice Hall.
4. Prece, Rogers and Sharps: Interaction Design; Wiley.
5. S. Lauesen: User Interface Design; Pearson Ed.

CS 1431 **COMPUTATIONAL GEOMETRY** **L T P C**
Pre-requisite- NIL **3-0-0-6**
Semester-7 (Elective II)

Introduction: Historical perspective, geometric preliminaries. Convex hulls algorithms in 2d and 3d, lower bounds
Triangulations: Polygon triangulations, representations, point-set triangulations
Voronoi diagrams: Algorithms, closest pair problems
Delaunay triangulations: Algorithms (divide-and-conquer, flip, incremental), duality of Voronoi diagrams, properties (min-max angle)
Geometric searching: Point-location, 2D linear programming with prune and search
Visibility: Algorithms for weak and strong visibility, visibility with reflections, art-gallery problems
Arrangements of lines: 2D arrangements, zone theorem, many-faces complexity, algorithms
Sweep techniques: Plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements
Combinatorial geometry: Ham-sandwich cuts, Helly's theorems, k-sets
Rectilinear geometry: Intersection and union of rectangles, rectangle searching
Robust geometric computing
Applications of computational geometry

Texts/Reference:

1. M. Berg, O. Schwarzkopf, M. Kreveld and M. Overmars: Computational Geometry: Algorithms and Applications; Springer.
2. F. P. Preparata and M. I. Shamos: Computational Geometry: An Introduction; Springer.
3. J. O. Rourke: Computational Geometry in C; Cambridge University Press.

CS 1432 **WIRELESS NETWORKS** **L T P C**
Pre-requisite- CS 1302 **3-0-0-6**
Semester-7 (Elective II)

Introduction to wireless communication systems and networks
Wireless technologies: Cellular wireless networks and systems principles, antennas and radio propagation, signal encoding and modulation techniques, spread spectrum, coding and error control
Wireless Networking: Multiple access techniques, Mobile IP and WAP, Wireless systems and standards
Wireless LANs: Wireless LAN technology, Wireless standard (IEEE 802.11 etc.), Ad-hoc Networks, Bluetooth

Texts/Reference:

1. T.S. Rappaport: Wireless Communications: Principles & Practice; Pearson Ed.
2. W. Stallings: Wireless Communications and Networks; Pearson Ed.

CS 1433 **INFORMATION THEORY AND CODING** **L T P C**
Pre-requisite- CS 1203, CS 1205 . **3-0-0-6**
Semester-7 (Elective II)

Introduction: Concept of entropy and mutual information, application of entropy in feature extraction
Entropy in stochastic processes: Entropy rates, markov chains, Hidden Markov models
Data Compression: Kraft inequality and optimal coding, Huffman codes and optimality, Shanon-Fano-Elias coding, Arithmetic codes
Channel capacity and Coding: Different channel models, concept of channel capacity, channel coding theorem, Fano's inequality, Huffman codes, channel capacity theorem, Shanon's limit, Random selection of codes, noiseless coding
Error control codes: Concept of Linear block codes, cyclic codes, BCH codes, RS codes, Convolution codes
Error Correcting techniques: Short-random-error correction by error-trapping, burst-error correction for block codes
Coding and Digital Modulation: Trellis coded modulation

Texts/Reference:

1. T. M. Cover and J. A. Thomas: Elements of Information Theory; Wiley.
2. R. Bose: Information Theory, Coding and Cryptography; TMH.
3. M. Y. Rhee: Error Correcting Coding Theory; McGraw-Hill.
4. R. H. Morelos-Zaragoza: The Art of Error Correcting Coding; Wiley.
5. S. Roman: Introduction to Coding and Information Theory; Springer.
6. W. C Huffman and V. Pless: Fundamentals of Error-Correcting Codes; Cambridge.
7. I.S Reed and X. Chen: Error Control Coding for Data Network; Kluwer.
8. G. Wada: Coding Techniques: an introduction to compression and error control; Palgrive.
9. P. Garret: The Mathemetics of Coding Theory; Pearson.

CS 1434 **DISTRIBUTED SYSTEM** **L T P C**
Pre-requisite- CS 1302, CS 1304. **3-0-0-6**
Semester-7 (Elective II)

Introduction: Concepts of distributed system and its general architecture, basic design issues in distributed system
Naming: Naming of entities and concept of name space, name space implementation, locating mobile entities
Process Management: Basic concepts of process and thread, threads in distributed system, code migration and its models, migration in heterogeneous environment, Introduction to RPC and RMI
Synchronization: Basic synchronization techniques, physical and logical clocks, clock synchronization algorithms, global state, election algorithms
Distributed mutual exclusion: Requirements, types and models of mutual Exclusion algorithms, discussion on mutual exclusion algorithms
Distributed deadlock handling: Introduction to deadlock, deadlock prevention and avoidance techniques, deadlock detection/ resolution algorithms
Agreement protocols: Basic concept of agreement protocols, different agreement problems, Byzantine agreement problem, Consensus problem, relations among agreement problems, solution to Byzantine agreement problem, application of agreement algorithm

Texts/Reference:

1. G. Coulouris, J. Dollimore and T. Kindberg: Distributed Systems: Concepts and Design; Pearson Ed.
2. M. Singhal and N. G. Shivaratri: Advanced Concepts in Operating System; TMH.
3. A. S. Tanenbaum and M. V. Steen: Distributed Systems: Principles and Paradigms; Pearson Ed.
4. P. K. Sinha: Distributed Operating System; PHI.
5. A. S. Tanenbaum: Distributed Operating Systems; Pearson Ed.

CS 1435 **DATA MINING** **L T P C**
Pre-requisite- CS 1306 **3-0-0-6**
Semester-7 (Elective II)

Introduction: Types of data mining problems, process of data mining
Statistical evaluation of big data: Statistical prediction, performance measures, pitfalls in data-mining evaluation
Data preparation: Data models, data transformations, handling of missing data, time-dependent data, textual data
Data reduction: Feature selection, principal components, smoothing data, case subsampling
Predictive modelling: Mathematical models, linear models, neural nets, advanced statistical models, distance solutions, logic solutions, decision trees, decision rules, model combination
Solution analyses: Graphical trend analyses, comparison of methods
Future trends: Text mining, visualization, distributed data. Use of open-source software

Texts/Reference:

1. J. Han and M. Kamber: Data Mining: Concepts and Techniques; Morgan Kaufmann.
2. P. Tan, M. Steinbach and V. Kumar: Introduction to Data Mining; Addison Wesley.
3. D. J. Hand, H. Mannila and P. Smyth: Principles of Data Mining; MIT Press.

CS 1436 **NATURAL LANGUAGE PROCESSING** **L T P C**
Pre-requisite- CS 1302, CS 1304 **3-0-0-6**
Semester-7 (Elective II)

Introduction: NLP tasks in syntax, semantics, and pragmatics, applications in information extraction, question answering, machine translation, problem of ambiguity, role of machine learning, brief history

N-gram language models: Role of language models, simple N-gram models, estimating parameters and smoothing,

evaluating language models
Part of speech tagging and sequence labelling: Lexical syntax, hidden markov models, maximum entropy models, conditional Random Fields
Syntactic parsing: Grammar formalisms and treebanks, efficient parsing for CFGs, statistical parsing and probabilistic CFGs (PCFGs), lexicalized PCFGs
Semantic Analysis: Lexical semantics and word-sense disambiguation, compositional semantics, semantic role labelling and semantic parsing

Texts/Reference:
1. D. Jurafsky and J. H. Martin: Speech and Language Processing; Prentice Hall.
2. C. Manning and H. Schütze: Foundations of Statistical Natural Language Processing; MIT Press.

CS 1441 **PRINCIPLES OF PROGRAMMING LANGUAGE** **L T P C**
Pre-requisite- CS 1201 **3-0-0-6**
Semester-8 (Elective III)

Introduction: Syntax, semantics and pragmatics, formal translation models
Variables, Expressions & Statements: Binding time spectrum, variables and expressions, assignment, lvalues and r-values, storage allocation, constants and initialization
Types: Primitive types, pointers, structured types, coercion, notion of type equivalence, polymorphism, encapsulation, information hiding and abstraction
Storage management: Static, dynamic, stack-based, heap-based
Sequence control: Implicit and explicit sequencing with arithmetic and non-arithmetic expressions, sequence control between statements
Subprogram control: Subprogram sequence control, data control and referencing environments, parameter passing, static and dynamic scope, block structure

Texts/Reference:
1. T.V. Pratt: Programming Languages; Pearson Ed.
2. K. C. Louden: Programming Languages: Principles and Practice; Addision-Wesley.
3. A. Tucker and R. Noonan: Programming Languages: Principles and Paradigms; TMH.

CS 1442 **APPLIED PARALLEL PROGRAMMING** **L T P C**
Pre-requisite- CS 1301 **3-0-0-6**
Semester-8 (Elective III)

Introduction, Introduction to CUDA C, CUDA Parallel Execution Model with Fermi updates, CUDA features and debugging, Memory bandwidth, Tiled Convolution, Parallel Computation Patterns - Reduction Trees, Parallel Computation Patterns - Prefix Sum (Scan), Floating Point Considerations, Atomic Operations and Histogramming, MPI and CUDA Programming

Texts/Reference:
1. D. B. Kirk and W. Hwu: Programming Massively Parallel Processors: A hands-on Approach; Morgan Kaufmann.
2. J. Sanders and E. Kandrot: CUDA by Example: An Introduction to General-Purpose GPU Programming; Addison-Wesley).

CS 1443 **PATTERN RECOGNITION** **L T P C**
Pre-requisite- CS 1201 **3-0-0-6**

Semester-8 (Elective III)

Introduction: Introduction to pattern recognition, applications of pattern recognition, statistical, neural and structural approaches
Statistical Pattern Recognition: Patterns and classifications, discriminant functions, Bayes decision rule, Nearest neighbour rule, probability of error
Linear Discriminant functions: Perceptrons and training, LMSE approaches, unsupervised learning and clustering, feature extraction
Syntactic Pattern Recognition: Formal languages and grammars, pattern grammars and higher dimensional grammars, parsing, automata realizations, stochastic grammars, grammatical interference, computation learning theory, Valiant's framework

Texts/Reference:

1. R. J. Schalkoff: Pattern Recognition: Statistical, Structural and Neural Approaches; Wiley.
2. R. O. Duda and P. E. Hart: Pattern Classification and Scene Analysis; Wiley.
3. L. Miclet: Structural methods in Pattern Recognition; North Oxford Academic.

CS 1444 **CRYPTOGRAPHY AND SECURITY** **L T P C**
Pre-requisite- CS 1433 **3-0-0-6**
Semester-8 (Elective III)

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory Probability and Information Theory
Cryptosystems: Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems, Shannon's Theory
Symmetric Key Ciphers: DES, AES
Cryptanalysis of Symmetric Key Ciphers: Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers
Stream Ciphers: Pseudorandom functions, Hash functions - The Merkle Damgard Construction, Message Authentication Codes (MACs)
Asymmetric Key Ciphers: RSA Cryptosystem, Primality Testing, Factoring Algorithms, Discrete Logarithm Problem (DLP) and the Diffie Hellman Key Exchange algorithm, ElGamal Encryption Algorithm, Cryptanalysis of DLP
Asymmetric Key Cryptography: Elliptic curve based cryptography
Security: Secret Sharing Schemes, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer

Texts/Reference:

1. D. Stinson: Cryptography Theory and Practice; Chapman & Hall/CRC.
2. C. K. Shyamala, N. Harini and T. R. Padmanabhan: Cryptography and Security; Wiley India.
3. O. Goldreich: Foundations of Cryptography, vol. I and vol. II; Cambridge Press.
4. Hoffstein, Pipher and Silvermman: An Introduction to Mathematical Cryptography; Springer.
5. A. Joux: Algorithmic Cryptanalysis; CRC Press.
6. B. A. Forouzan: Cryptography & Network Security; TMH.
7. W. Stallings: Cryptography and Network Security; TMH.
8. S. G. Telang: Number Theory; TMH.

CS 1445 **VLSI DESIGN, TEST AND VERIFICATION** **L T P C**
Pre-requisite- CS 1301, CS 1401, CS 1404 **3-0-0-6**
Semester-8 (Elective III)

Introduction: Digital VLSI Design Flow Specification, High level Synthesis, RTL Design, Logic Optimization, Verification and Test Planning, Design Representation, Hardware Specific Transformations
Scheduling, Allocation and Binding: Basic Scheduling Algorithms (Time constrained and Resource Constrained), Allocation Steps - Unit Selection, Functional Unit Binding, Storage Binding, Interconnect Binding, Allocation Techniques - Clique Partitioning, Left-Edge Algorithm, Iterative Refinement
Logic Optimization and Synthesis: Heuristic Minimization of Two-Level Circuits, Finite State Machine Synthesis, Multi-Level Logic Synthesis, Multi-Level Minimization

Binary Decision Diagram: Introduction and construction, Reduction rules and Algorithms, Operation on BDDs and its Algorithms, Representation of Sequential Circuits
Temporal Logic: Introduction and Basic Operators, Syntax and Semantics of LTL, CTL and CLT*, Equivalence and Expressive Power
Digital Testing: Introduction, Test process and Test economics, Functional vs. Structural Testing Defects, Errors, Faults and Fault Modelling (stuck at fault modelling), Fault Equivalence, Fault Dominance, Fault Collapsing and Checkpoint Theorem
Fault Simulation: Circuit Modelling and Algorithms for Fault Simulation, Serial Fault Simulation, Parallel Fault Simulation, Deductive Fault Simulation, Concurrent Fault Simulation
Circuit Testing: Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras, D-Calculus and D-Algorithm, Basics of PODEM and FAN, ATPG for Single-Clock Synchronous Circuits, Introduction to BIST architecture BIST Test Pattern Generation

Texts/Reference:

1. D. D. Gajski, N. D. Dutt, A. C. H. Wu and S. Y. L. Lin: High-Level Synthesis: Introduction to Chip and System Design; Springer.
2. S. Palnitkar: Verilog HDL: A Guide to Digital Design and Synthesis; Prentice Hall.
3. G. D. Micheli: Synthesis and optimization of digital circuits; TMH.
4. M. Huth and M. Ryan: Logic in Computer Science modelling and reasoning about systems; Cambridge Press.
5. Bushnell and Agrawal: Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits; Kluwer Academic Publishers.

CS 1446 **LINUX OPERATING SYSTEM** **L T P C**
Pre-requisite- CS 1304 **3-0-0-6**
Semester-8 (Elective III)

Introduction, Process management, Process scheduling, System calls, Interrupts and interrupt handlers, Memory management, VFS, Block I/O layer

Texts/Reference:

1. R. Love: Linux Kernel Development; Pearson Education.
2. D. P. Bovet: Understanding the Linux Kernel; O'reilly.

CS 1451 **INTRODUCTION TO NETWORK CALCULUS** **L T P C**
Pre-requisite- CS 1203, CS 1205, CS 1302, CS 1423 **3-0-0-6**
Semester-8 (Elective IV)

Network Calculus: Models for Data Flows, Arrival Curves, Service Curves, Network Calculus Basics, Greedy Shapers, Maximum Service Curve, Variable and Fixed Delay, Handling Variable Length Packets, Lossless Effective Bandwidth and Equivalent Capacity
Mathematical Background: Basic Min-plus and Max-plus Calculus, Min-Plus Calculus, Max-Plus Calculus, Min-plus and Max-Plus System Theory, Min-Plus and Max-Plus Operators, Closure of an Operator
Application of Network Calculus to the Internet: GPS and Guaranteed Rate Schedulers, The Integrated Services Model of the IETF, Schedulability, Application to Differentiated Services
Optimal Multimedia Smoothing: Constraints Imposed by Lossless Smoothing, Minimal Requirements on Delays and Playback Buffer, Optimal Smoothing Strategies, Optimal Constant Rate Smoothing, Optimal Smoothing versus Greedy Shaping, Comparison with Delay Equalization
FIFO Systems and Aggregate Scheduling: Introduction, General Bounds for Aggregate Scheduling, Stability of a Network with Aggregate Scheduling, Bounds for a FIFO Service Curve Element, Bounds for a Network of FIFO CBR Servers
Packet Scale Rate Guarantees: Introduction, Adaptive Guarantee, Application to the Internet - Packet Scale Rate Guarantee
Time Varying Shapers: Introduction, Time Varying Shapers, Time Invariant Shaper with Non-zero Initial Conditions, Time Varying Leaky-Bucket Shaper
Stochastic Network Calculus: Traffic Models for Stochastic Network Calculus, Server Models for Stochastic Network Calculus, Basic Properties of Stochastic Network Calculus, Analysis on Scheduling Disciplines

Texts/Reference:

1. J. Y. Le Boudec, P. Thiran: Network Calculus; Springer, LNCS 2050.
2. Y. Jiang and Y. Liu: Stochastic Network Calculus; Springer.

3. A. Kumar, D. Manjunath and J. Kuri: Communication Networking: An Analytical Approach; Elsevier.

CS 1452 **LOGIC OF COMPUTER SCIENCE** **L T P C**
Pre-requisite- CS 1203, CS 1204, CS 1402 **3-0-0-6**
Semester-8 (Elective IV)

Propositional Logic: Orders and Trees, Propositions, Connectives, Truth Tables, Truth Assignments, Valuations, Tableau Proofs in Propositional Calculus, Soundness and Completeness of Tableau Proofs, Deductions from Premises and Compactness, Resolution, Refining Resolution, Linear Resolution, Horn Clause and PROLOG
Predicate Logic: Predicates and Quantifiers, Terms and Formulas, Formation Trees, Structures, Lists, Semantics - Meaning and Truth, Proofs - Complete Systematic Tableaux, Soundness and Completeness of Tableau Proofs, Prenex Normal Form, Skolemization, Herbrand's Theorem, Unification, Unification Algorithm, Resolution, Linear Resolution
Modal Logic: Possibility and Necessity, Knowledge or Belief, Frames and Forcing, Modal Tableaux, Soundness and Completeness

Texts/Reference:
1. A. Nerode and R. A. Shore: Logic for Applications; Springer.
2. M. Fitting: First-Order Logic and Automated Theorem Proving; Springer.
3. M. Ben-Ari: Mathematical Logic for Computer Science; Springer.

CS 1453 **WIRELESS SENSOR NETWORK** **L T P C**
Pre-requisite- CS 1205, CS 1302, CS 1432 **3-0-0-6**
Semester-8 (Elective IV)

Introduction to sensor network, Unique constraints and challenges, Localization and Tracking, Networking Sensors, Infrastructure establishment, Sensor Tasking and Control, Sensor network databases, Sensor Network Platforms and tools, Industrial Applications and Research directions

Texts/Reference:
1. F. Zhao and L. Guibas: Wireless Sensor Networks: An Information Processing Approach; Elsevier.
2. I. Stojmenovi and Cacute: Handbook of Sensor Networks: Algorithms and Architectures; Wiley.

CS 1454 **SPEECH PROCESSING** **L T P C**
Pre-requisite- CS 1205 **3-0-0-6**
Semester-8 (Elective IV)

Fundamentals of speech science, Modelling speech production, Short-term processing of speech, Linear prediction analysis, Cepstral analysis, Speech coding and synthesis, Speech enhancement, Recognition using templates and DTW, Recognition using hidden Markov models

Texts/Reference:
1. J. Deller, J. Hansen and J. Proakis: Discrete-Time Processing of Speech Signals; Wiley-IEEE.
2. Rabiner and Schafer: Digital Processing of Speech Signals; Prentice Hall.
3. T. F. Quatieri: Discrete-Time Speech Signal Processing: Principles and Practice; Prentice Hall.

CS 1455 **FORMAL METHODS OF SYSTEM VERIFICATION** **L T P C**
Pre-requisite- CS 1205 **3-0-0-6**
Semester-8 (Elective IV)

Introduction: Formal methods and hardware verification, Review of Propositional Calculus and Predicate Calculus, Axioms and rules of Floyd-Hoare Logic, Application of Floyd-Hoare logic to verify hardware circuits, Describing hardware directly in higher order logic
Circuit representation: Combinational and sequential behaviour of circuits, Specification of hardware systems, Concept of OBDDs and ROBDDs and operation on ROBDDs

State space explosion problem: Symbolic data structure and symbolic model checking algorithms, Concept of on-the-fly model checking and automata-theoretic model checking Study of verification tools: SMV and PVS

Texts/Reference:

1. M. Huth and M. Ryan: Logic in Computer Science: Modelling and Reasoning about Systems; Cambridge University Press.
2. T. F. Melham: Higher Order Logic and Hardware Verification; Cambridge University Press.
3. E. M. Clarke, O. Grumberg and D. Peled: Model Checking; MIT Press.
4. K. L. McMillan: Symbolic Model Checking; Kluwer Academic Publisher.

CS 1456 **NETWORK STORAGE MANAGEMENT** **L T P C**
Pre-requisite- CS 1304, CS 1307 **3-0-0-6**
Semester-8 (Elective IV)

Storage System: introduction, storage system environment – Disk drive components, Data protection - RAID, Intelligent storage system
Storage networking technologies and virtualization: Direct-attached storage, introduction to SCSI, SAN, Network attaché storage, IP SAN, content-addressed storage, virtualization
Business Continuity: Backup and recovery Storage security and management

Texts/Reference:

1. G. Somasundaram and A. Shrivastava: Information Storage and Management Storing, Managing and protecting Digital information; Wiley.

CS 1471 **NEURAL NETWORK** **L T P C**
Pre-requisite- NIL **3-0-0-6**
Semester-8 (Open Elective)

Introduction: Biological neurons and artificial neurons, Model of an ANN, Activation functions used in ANNs, Typical classes of network architectures
Mathematical Foundations and Learning mechanisms: Re-visiting vector and matrix algebra, Statespace concepts, Concepts of optimization, Error-correction learning, Memory-based learning, Hebbian learning, Competitive learning
Single layer perceptrons: Structure and learning of perceptrons, Pattern classifier-introduction and Bayes' classifiers, Perceptron as a pattern classifier, Perceptron convergence, Limitations of perceptrons
Feedforward ANN: Structures of Multi-layer feedforward networks, Back propagation algorithm, Back propagation - training and convergence, Functional approximation with back propagation, Practical and design issues of back propagation learning
Radial Basis Function Networks: Pattern separability and interpolation, Regularization Theory, Regularization and RBF networks, RBF network design and training, Approximation properties of RBF
Support Vector machines: Linear separability and optimal hyperplane, Determination of optimal hyperplane, Optimal hyperplane for nonseparable patterns, Design of an SVM, Examples of SVM
Competitive Learning and Self organizing ANN: General clustering procedures, Learning Vector Quantization (LVQ), Competitive learning algorithms and architectures, Self organizing feature maps, Properties of feature maps

Texts/Reference:

1. S. Haykin: Neural Networks: A comprehensive foundation; Pearson Education.
2. S. Kumar: Neural Networks: A classroom approach; TMH.
3. R. J. Schalkoff: Artificial Neural Networks; McGraw-Hill.
4. D. W. Patterson: Artificial Neural Networks: Theory and Applications; Prentice Hall.
5. Hertz, Krogh and Palmer: Introduction to the Theory of Neural Computation; Addison-Wesley.

CS 1472 **TIME SERIES ANALYSIS** **L T P C**
Pre-requisite- MA 1201(Prob. & Statistics) **3-0-0-6**
Semester-8 (Open Elective)

Models for time series: Time series data, Trend, seasonality, cycles and residuals, Stationary processes, Autoregressive processes, Moving average processes, White noise

Models of stationary processes: Purely indeterministic processes, ARMA processes, ARIMA processes, Estimation of the autocovariance function, Identifying a MA(q) process, Identifying an AR(p) process, Distributions of the ACF and PACF
Spectral methods: Discrete Fourier transform, Spectral density, Analysing the effects of smoothing
Estimation of the spectrum: Periodogram, Distribution of spectral estimates, Fast Fourier transform
Linear filters: Filter Theorem, Application to autoregressive processes, Application to moving average processes, General linear process, Filters and ARMA processes, Calculating autocovariances in ARMA models
Estimation of trend and seasonality: Moving averages, Centred moving averages, Slutzky-Yule effect, Exponential smoothing, Calculation of seasonal indices
Fitting ARIMA models: Box-Jenkins procedure, Identification, Estimation, Verification, Tests for white noise, Forecasting with ARMA models
State space models: Models with unobserved states, Kalman filter, Prediction, Parameter estimation

Texts/Reference:

1. P. J. Brockwell and R. A Davis: Time Series: Theory and Methods; Springer.
2. C. Chatfield: The Analysis of Time Series: Theory and Practice; Chapman and Hall.
3. M. Kendall: Time Series; Charles Griffin.
4. G. E. P. Box, G. Jenkins and G. Reinsel: Time Series Analysis-Forecasting and Control; Pearson Education.

CS 1481 **SOFT COMPUTING TECHNIQUES FOR NON-LINEAR OPTIMIZATION** **L T P C 3-0-0-6**

Pre-requisite- NIL
Semester-8 (Open Elective)

Soft and hard computing
GA: Gene, Chromosome, Allele, Schemata theory, genotype, phenotype, competition and Selection – different types, Crossover –different techniques, elitism, mutation – different types, stopping criteria, Flow-chart of GA
Evolutionary algorithm: Simulated Annealing, Evolutionary programming, Hill climbing
Fuzzy: Membership function, fuzzyfication function, fuzzy operator, inference rules, defuzzyfication
Exploration and exploitation PSO, Ant Colony Optimization

Texts/Reference:

1. D. E. Goldberg: Genetic Algorithms in Search, Optimization, and Machine Learning; Addison-Wesley.
2. S. Rajasekaran and G. A. V. Pai: Neural Network, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications; PHI.
3. N. K. Sinha and M. M. Gupta: Soft Computing and Intelligent Systems: Theory and Application; Academic Press.

CS 1482 **CLOUD COMPUTING** **L T P C 3-0-0-6**

Pre-requisite- NIL
Semester-8 (Open Elective)

Introduction: Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS
Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing
Cloud Technologies: Study of Hypervisors, Compare SOAP and REST
Web services: SOAP and REST, SOAP versus REST, AJAX - asynchronous 'rich' interfaces, Mashups - user interface services
Virtualization: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization
Multitenant software: Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications
Data in the cloud: Relational databases, Cloud file systems - GFS and HDFS, BigTable, HBase and Dynamo

Map-Reduce and extensions: Parallel computing, The Map-Reduce model, Parallel efficiency of Map- Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-Reduce, Features and comparisons among GFS,HDFS etc, Map-Reduce model

Cloud security: Vulnerability assessment tool for cloud, Privacy and Security in cloud, Architectural Considerations - General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Security challenges - Virtualization security management- virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud

Issues: Implementing real time application over cloud platform

Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment

Texts/Reference:

1. J. Hurwitz, R. Bloor, M. Kanfman and F. Halper: Cloud Computing for Dummies; Wiley India.
2. G. Shroff: Enterprise Cloud Computing; Cambridge University Press.
3. R. Krutz and R. D. Vines: Cloud Security; Wiley India.

Course Structure for B Tech (4 Year, 8 Semester Course) Electronics and Communication Engineering
(to be applicable from 2012 entry batch onwards)

Course No	Course Name	L	T	P	C		Course No	Course Name	L	T	P	C
Semester-1							**Semester-2**					
CH-1101 /PH-1101	Chemistry/Physics	3	1	0	8		EC-1101	Basic Electronics	3	0	0	6
EE-1101	Basic Electrical Engineering	3	0	0	6		CS-1101	Introduction to Computing	3	0	0	6
MA-1101	Mathematics-I	3	1	0	8		MA-1102	Mathematics-II	3	1	0	8
CE-1101	Engineering Graphics	1	0	3	5		ME-1101	Engineering Mechanics	3	1	0	8
HS-1101	Communication Skills	3	0	0	6		PH-1101/ CH-1101	Physics/Chemistry	3	1	0	8
CH-1111 /PH-1111	Chemistry/Physics laboratory	0	0	2	2		CS-1111	Computing Laboratory	0	0	2	2
ME-1111	Workshop	0	0	3	3		EE-1111	Electrical Science Laboratory	0	0	2	2
	Physical Training-I	0	0	2	0		PH-1111/ CH-1111	Physics/Chemistry Laboratory	0	0	2	2
	NCC/NSO/NSS	0	0	2	0			Physical Training –II	0	0	2	0
								NCC/NSO/NSS	0	0	2	0
		13	**2**	**8**	**38**				**15**	**3**	**6**	**42**
Semester-3							**Semester-4**					
MA-1201	Mathematics-III	3	1	0	8		EC-1204	Principles of Communication Engineering	3	1	0	8
EC -1201	Signals, Systems & Networks	3	1	0	8		EC-1205	Pulse and Digital Electronic Circuits	3	1	0	8
CS-1201	Data Structure	3	1	0	8		EC-1206	Analog Integrated Circuits and Technology	3	1	0	8
EC-1202	Analog Electronic Circuits	3	1	0	8		EC-1207	Probability and Random Processes	3	1	0	8
EC-1203	Semiconductor Devices and Circuits	3	0	0	6		HS-1201	Managerial Economics	3	0	0	6
EC-1211	Electronics Laboratory-I	0	0	2	2		EC-1212	Electronics Laboratory-II	0	0	2	2
	Physical Training - III	0	0	2	0			Physical Training - IV	0	0	2	0
	NCC/NSO/NSS	0	0	2	0			NCC/NSO/NSS	0	0	2	0
		15	**4**	**2**	**40**				**15**	**4**	**2**	**40**
Semester-5							**Semester-6**					
EC 1301	Digital Communication	3	1	0	8		EC 1306	Digital Signal Processing	3	0	0	6
EC 1302	Computer Organization and Microprocessors	3	0	0	6		EC 1307	Data Communication and Networks	3	0	0	6
EC 1303	Introduction to VLSI Design	3	0	0	6		EC 1308	RF and Microwave Engineering	3	0	0	6
EC 1304	Electro Magnetic Field Theory and Wave Propagation	3	1	0	8		EC 1309	Measurement and Instrumentation	3	1	0	8
HS 1301	Business Management	3	0	0	6		EC 1310	Control System	3	1	0	8
EC-1311	Electronics Lab-III	0	0	2	2		EC 1314	Design Laboratory	0	0	2	2
EC 1312	Electronics Lab-IV	0	0	2	2		EC 1315	Electronics Laboratory-VI	0	0	2	2
EC 1313	Electronics Lab-V	0	0	2	2		EC 1316	Electronics Laboratory-VII	0	0	2	2
		15	**2**	**6**	**40**				**15**	**2**	**6**	**40**
Semester-7							**Semester-8**					
EC-1401	Principle of Optoelectronics and Fibre Optics	3	0	0	6		EC-1403	Advanced Communication Engineering	3	0	0	6
EC-1402	Power Electronics	3	0	0	6		EC-1XXX	Dept. Elective - III	3	0	0	6
EC-1XXX	Dept. Elective - I	3	0	0	6		EC-1XXX	Dept. Elective - IV	3	0	0	6
EC-1XXX	Dept. Elective - II	3	0	0	6		EC-1XXX	Dept. Elective - V	3	0	0	6
XX-1XXX	Open Elective - I	3	0	0	6		XX-1XXX	Open Elective - II	3	0	0	6
EC-1411	Electronics Laboratory-VIII	0	0	2	2		EC-1491	Project - II	0	0	10	10
EC-1490	Project - I	0	0	8	8							
		15	**0**	**10**	**40**				**15**	**0**	**10**	**40**

NB: Industrial Training after Sixth Semester for a period of 4-6 weeks as an audit course.
E1111 will be jointly offered by EE and EC Departments

LIST OF ELECTIVES -

	Elective-I
EC-1421	Advanced Microprocessors
EC-1422	Optical Communication Networks
EC-1423	Digital Image Processing
EC-1424	Satellite Communication
EC-1425	Information Theory, Coding and Cryptography
EC-1426	Biomedical Instrumentation
EC-1427	Biomedical Signal Processing
EC-1428	Embedded Systems
EC-1429	Analog and Digital Filter Design
	Elective-II
EC-1431	Architecture of Digital Signal Processors
EC-1432	Advanced VLSI Design
EC-1433	Advanced Optical Communication
EC-1434	Advanced Topics in Digital Signal Processing
EC-1435	Antenna & Wave Propagation
EC-1436	Detection & Estimation Theory
EC-1437	Smart Antennas for Wireless Communication
EC-1438	Reconfigurable Computing and Reconfigurable Hardwares
EC-1439	Optimal and Adaptive Control System
	Open Elective -I
EC-1471	Neural Networks and Fuzzy Logic
EC-1472	Process Control and Instrumentation
EC-1473	Micro Electro Mechanical Systems (MEMS)
EC-1474	Special Topics on Device and Circuit
EC-1475	Special Topics on VLSI
EC-1476	Special Topics on Communication and Signal
EC-1477	Special Topics in Control and Instrumentation
EC-1478	Special Topics on Power Electronics

	Elective-III
EC-1441	VLSI-DSP Based Design
EC-1442	Analog IC Design
EC-1443	Adaptive Signal Processing
EC-1444	Mobile and Cellular Communication
EC-1445	Data Mining
EC-1446	Telemetry
EC-1447	CAD for VLSI
	Elective-IV
EC-1451	Digital Speech Processing
EC-1452	Industrial Instrumentation
EC-1453	Advanced Instrumentation
EC-1454	Advanced Topics in Wireless Communication
EC-1455	Low Power VLSI Design
EC-1456	VLSI for Signal Processing and Communication
EC-1457	Simulation of devices and Circuits
	Elective-V
EC-1461	Advanced Computer Organization &Architecture
EC-1462	Under Water Acoustics
EC-1463	Audio/Video Electronics and Broadcasting
EC-1464	Telecommunication Switching and Networks
EC-1465	RF and Microwave Integrated Circuits
EC-1466	Topics in Information Security
EC-1467	Adhoc and Sensor Networks
	Open Elective -II
EC-1481	Optimization Methods in Engineering
EC-1482	Machine Intelligence
EC-1483	Human-Computer Interface
EC-1484	Nano-Technology
EC-1485	Selected Topics on Device and Circuit
EC-1486	Selected Topics on VLSI
EC-1487	Selected Topics on Control and Instrumentation
EC-1488	Selected Topics on Communication and Signal
EC-1489	Selected Topics on Power Electronics

EC 1101 **BASIC ELECTRONICS** **L T P C 3-0-0-6**

Pre-requisite- Physics, Basic Electrical

Semester: 2

Junction Diode: VI characteristics, large and small signal models and applications.
BJTs and FETs:
BJT: Constructional details, transistor current components, regions of operation, transistor as an amplifier, CB, CE and CC configuration, their input and output characteristics, transistor biasing, DC and AC load line, hybrid-π model.
FET: General description of FET, constructional details, pinch off voltage, JFET volt ampere characteristics, transfer characteristics, MOSFET and its characteristics, FET biasing, small signal FET model.
BJT and FET as amplifiers and switches:
Amplifiers: CE amplifier, its graphical analysis, effect of Q point and R_L on the amplifying action, determination of voltage gain, current gain, input and output resistance, frequency response of CE amplifier, FET amplifying action.
Switches: BJT as switches, its input-output waveform, transistor switches with capacitive load, MOSFET as switch and loads.
Introductory concept of digital systems: Introductory concept of a digital system, number systems, Boolean algebra, logic functions, logic gates, simplification of logical functions, SOP and POS form, K-map.
Operational amplifier: Differential amplifier, differential and common mode operation, CMRR, application of op-amps: adder, subtractor, integrator, and differentiator.
Power supplies and voltage regulators:
Rectifiers, capacitor filters, RC and LC filters, voltage multipliers, voltage regulation, and series voltage regulators using Zener diode.

Text/Reference books:

1.	Microelectronic Circuits	Sedra/Smith	Oxford University Press
2.	Microelectronics	Millman and Grabel	TMH
3.	Digital Design	M. Morris Mano	Pearson
4.	Fundamentals of Digital Electronics	A Anand Kumar	PHI
5.	Integrated Electronics	Millmann, Halkias	TMH

EE 1111 **ELECTRICAL SCIENCES LABORATORY** **L T P C 0-0-2-2**

Pre-requisite-Basic Electronics Theory

Semester: 2

Part-I: From Electronics and Communication Engineering:

1. Introduction: safety, identification of electronic components, wiring your circuits, debugging, running the experiments, ground connection, and lab reports.
2. Measurement using CRO.
3. Diodes and their applications (full/half wave rectifier using center tapped transformer and bridge rectifier circuits).
4. BJTs and amplifiers.
5. MOSFET characteristics and applications.
6. Basic characteristics of Op-Amps and applications.
7. Boolean function realization using gates.
8. Realization of other gates using universal gates.

Part-II: From Electrical Engineering

1. Calibration of millimeter as a Voltmeter.
2. Measurement of Power and Power factor using three ammeter methods.
3. Measurement of Power and Power factor using three Wattmeter methods.
4. V-I Characteristics of Lamp.
5. Energy Measurement using energy meter.
6. To determine the value of parameters of a series RC Circuit.
7. Determination of self inductance of a coil at different core position.

8. Experiment on step-up/step-down transformer.
9. Short circuit test and open circuit test of Transformer.
10. V-I Characteristics of Diode.
11. To measure the supply frequency using series resonance circuit.
12. To verify Thevenin's theorem, Norton's theorem and maximum power transfer theorem.

EC 1201 **SIGNALS, SYSTEMS, AND NETWORKS** **L T P C 3-1-0-8**

Pre-requisite- Basic Electrical, Network Theorems, Mathematics

Semester: 3

Signal and System: Introduction, Continuous Time (CT) and Discrete Time (DT) Signals, transformation of the Independent variables, Exponential and sinusoidal Signals, Unit Impulse and Unit step Function, Continuous Time and Discrete Time Systems, Basic System properties.
Linear Time Invariant (LTI) System: Introduction, Discrete Time Linear Time Invariant Systems: The Convolution Sum, CT LTI : The Convolution Integral, Properties of LTI systems, Casual LTI Systems described by Differential and Difference equations.
Fourier Series Representation of Periodic Signals : Introduction, Fourier Series representation of CT Periodic Signals, Convergence of the Fourier series, Properties of CT Fourier series, Fourier series representation of DT periodic signals, Properties of DT Fourier series.
The Continuous Time Fourier Transform : Representation of Aperiodic signals, the CT Fourier Transform, the Fourier Transform for periodic signals, Properties of the CT Fourier Transform, the Convolution property, the Multiplication property, Systems characterised by linear constant co-efficient Differential equations.
The Discrete Time Fourier Transform : Representation of Aperiodic signals, the DT Fourier Transform, the Fourier Transform for periodic signals, Properties of the DT Fourier Transform, the Convolution property, the Multiplication property, Systems characterised by linear constant co-efficient Difference equations.
The Laplace Transform : Introduction, properties of the Laplace Transform, Inverse Laplace Transform, Analysis and characterisation of LTI systems using Laplace Transform, switching transient analysis using Laplace Transform.
The Z- Transform : Introduction, the Z- transform, the region of convergence for the Z-transform, the inverse Z-transform, properties of Z- transform, Analysis & characterisation of LTI systems using Z- transform, System function algebra and block diagram representations.
Networks : Topological description, Network theorems, Two Port analysis.

Text Books:

1.	Signals and Systems	A.V. Oppenheim, A.S. Willsky and H.S. Nawab	Prentice Hall of India
2.	Fundamentals of Signals and Systems	M. J. Roberts	Tata McGraw Hill
3.	Network Analysis	M. E. Van Valkenburg	Prentice Hall of India

References:

1.	Signal Processing and Linear Systems	B. P. Lathi	Oxford University Press
2.	Signals and Systems - Continuous and Discrete	R.F. Ziemer, W.H. Tranter and D.R. Fannin	Prentice Hall of India
3.	Signals and Systems	Simon Haykin, Barry van Veen	John Wiley and Sons
4.	Basic Circuit Theory	C. A. Desoer and E. S. Kuh	Tata McGraw Hill
5.	Network Analysis and Synthesis	F. F. Kuo	Wiley India

CS 1201 **DATA STRUCTURE** **L T P C 3-1-0-8**

Pre-requisite- C language, Basics of computers

Semester: 3

Introduction: Introduction to data types, Data structures and Abstract Data Types (ADT), Time and Space analysis of Algorithms- Order Notations.
Lists: Linked list, Stack, Queue and Recursion, their implementation.
Trees: Introduction, Binary tree, Binary search tree (BST), AVL trees, B Trees, B^+ Trees; Implementation of dictionary and binary search tree, hashing and hash table.

Graphs: Basic concepts, representations, Breadth-first and Depth-first Search.
Sorting & Searching: Different sorting techniques, Tree searching and graph searching techniques.
Memory management issues: Introduction, storage allocation, garbage collection, compaction.

Text/Reference books:

1.	Data Structures using C/C++	A.S.Tanenbaum, Y.Langsam, M.J.Augenstein	Prentice Hall of India
2.	Data Structure	V. Aho, J.D. Ullman	Addision-Wesley
3.	The Art of Computer Programming (Vol. 1, 2, 3)	D.E. Knuth	Addision-Wesley
4.	Fundamentals of Data Structures	E. Horowitz, S. Sahni	Galgotia Publication
5.	Algorithms, Data Structures, Programs	N. Wirth	Prentice Hall of India

EC 1202 **ANALOG ELECTRONIC CIRCUITS** **L T P C 3-1-0-8**

Pre-requisite- Basic Electronics, Physics of semiconductor, Basic Electrical

Semester: 3

The Bipolar Junction Transistors: Basic BJT, DC Analysis of Transistors Circuits, BJT Biasing, Multistage Circuits.
BJT and MOSFET Amplifiers: Analog Signals and Linear Amplifiers, Three Basic Amplifiers: Comparison, Multistage Amplifiers, Power Considerations.
Amplifier Frequency Response: Amplifier frequency response, System transfer functions, Frequency response: Transistor amplifiers with Circuit Capacitors, Frequency Response: BJT & FET, High Frequency Response of Transistor Circuits.
Ideal Operational Amplifiers & Op-Amp Circuits: Fundamental Op-Amp circuits, input, gain, and output stages, Parameters of practical Op-Amp, and Op-Amp applications.
Feedback and Stability: Introduction to feedback, Basic feedback Concept, Ideal Feedback Topologies, Analysis of Feedback Amplifiers: Series – Shunt, Series – Series, Shunt – Shunt, Shunt – Series, Stability Analysis, Compensation Technique.
Large Signal and power amplifiers: Harmonic distortion and power output, class A, class B, class AB, and class C amplifiers and their analysis. Thermal design considerations.

Text/Reference books:

1.	Electronic Circuits: Analysis and Design	Donald A Neamen	TMH
2.	Microelectronics Circuits	Sedra and Smith	Oxford University Press
3.	Microelectronics	Behzad Razavi	Wiley India Pvt Ltd
4.	Microelectronics	Millman and Grabel	TMH
5.	Microelectronic Circuits: Analysis and Design	Rashid	Cengage Engineering

EC 1203 **SEMICONDUCTOR DEVICES AND CIRCUITS** **L T P C 3-0-0-6**

Pre-requisite- Physics, Mathematics

Semester: 3

Review of semiconductor Physics: Solids, crystals, energy band, electrons, holes, effective mass, doping, Fermi level, carrier concentration, drift, mobility, generation and recombination, lifetime, diffusion, continuity equation, carrier transport phenomena.
p-n junctions: Thermal equilibrium conditions, depletion regions, depletion capacitance, current-voltage characteristics, charge storage and transient behavior, junction breakdown.
Bipolar Junction Transistor: The transistor action, static characteristics of BJT, frequency response and switching of BJT, the heterojunction BJT.

MOSFET and related devices: Introduction, MOS capacitor, capacitance voltage characteristics of MOS structure, MOSFET basic characteristics, the CMOS inverter, the thin film transistor (TFT)
Metal semiconductor contacts: Metal semiconductor contacts, the Schottky barrier, the ohmic and rectifying contacts.

Text/Reference books:

1.	Solid State Electronics Devices	Streetman and Banerjee	PHI
2.	Introduction to Semiconductor Materials and Devices	M. S. Tyagi	Wiley India Pvt Ltd
3.	Semiconductor Devices: Physics & Technology	S. M. Sze	John Wiley & Sons

EC 1211 **ELECTRONIC LABORATORY – I (LEC)** **L T P C 0-0-2- 2**

Pre-requisite- Basic Electronics

Semester: 3

LIST OF THE EXPERIMENTS:
1. Design a transistor bias circuit.
2. Design a two stage RC coupled amplifier-using BJT.
3. Design a single stage amplifier using FET.
4. Design a power supply with C filter.
5. Design a voltage regulator.
6. Design a push pull class B amplifier without input and output transformer.
7. Design an integrator.
8. Design a differentiator.
9. Design a smith trigger.
10. Design a monostable/astable multivibrator.

EC 1204 **PRINCIPLE OF COMMUNICATION ENGINEERING** **L T P C 3-1-0-8**

Pre-requisite- Signal & System

Semester: 4

Introduction: Historical Review, Elements of an Electrical Communication System, Communication Channel and their Characteristics, Mathematical Models for Communication Channels.
Review of Signals and Systems: Review of Fourier Transform, Rayleigh's Energy Theorem, the inverse relationship between time and frequency, Dirac Delta Function, transformation of signals through Linear systems, Paley-Wiener Criterion, Hilbert transform, Band Pass signals, Transmission of Band Pass signals, Phase and group delay.
Analog Signals Transmission and Reception: Introduction, Amplitude Modulation, Double side Band Suppressed carrier Amplitude Modulation, Single side band Amplitude Modulation, Vestigial side band Modulation, Implementation of AM Modulators and De-Modulators, Frequency division Multiplexing, Angular Modulation, representation of FM and PM signals, Spectral Characteristic of Angular Modulated Signals, Implementation of Angle Modulators and De-Modulators, AM Radio Broadcasting, FM Radio Broadcasting.
Effect of Noise on Analog communication System: Effect of Noise on AM, Effect of Noise on DSB-SCM, Effect of Noise on SSB-AM, Carrier Phase Estimation with Phase Locked loop, Effect of Noise on Angle Modulation, Threshold Effect in Angle Modulation, Pre-emphasis and De-emphasis in FM.
Pulse modulation: Introduction, sampling process, pulse amplitude modulation (PAM), PPM, PWM, PDM, TDM, bandwidth-noise trade-off, Nyquist sampling theorem.

Text Books:

1.	Communication Systems	Simon Haykin	John Willey & Sons

Reference Books:

1.	Communication Systems Engineering	Proakis & Salehi	Pearson Education
2.	Communication Systems	A.B.Carlson	TMH/MGH
3.	Communication Theory	T.G.Thomas & S Chandrasekhar	TMH/MGH
4.	Principle of Communication Systems	H.Taub & D.L.Schilling	TMH/MGH
5.	Communication Theory	T.G.Thomas & S Chandrasekhar	TMH/MGH

EC 1205 **PULSE AND DIGITAL ELECTRONIC CIRCUITS** **L T P C 3-1-0-8**

Pre-requisite- Analog and Digital Electronics

Semester: 4

Linear Wave Shaping: Response to sinusoidal, Step, Pulse, Exponential and Ramp input to RC high-pass and low-pass circuits.
Logic gates: Transfer characteristics, propagation delays, power consumption, fan-in, fan-out, TTL, ECL and MOS logic circuits.
Number systems and codes: Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes.
Sequential circuits: Flip-flops- RS, JK, D-type, T-type and master-slave flip-flops. Flip-flop specifications. Counters – Binary, ripple, synchronous, Mod-K and decade counters and their design, Shift registrars and multivibrators.
Combinational and Arithmetic circuits: Multiplexers, demultiplexers, decoders, encoders, parity checkers, half and full adders.
DAC and ADC: Weighted resistance DAC, R-2R ladder network, flash ADC, single and dual slope ADC, successive approximation ADC.

Text/Reference books:

1.	Pulse, Digital and switching Waveforms	Millman and Taub	TMH
2.	Fundaments of Digital Circuits	A. Anand Kumar	PHI
3.	Microelectronics	Millman and Grabel	TMH
4.	Digital Design	M. Morris Mano	Pearson
5.	Modern Digital Electronics	R. P. Jain	TMH

EC 1206 **ANALOG INTEGRATED CIRCUITS AND TECHNOLOGY** **L T P C 3-1-0-8**

Pre-requisite- Physics of semiconductors, Analog electronic circuits

Semester: 4

Electronic Grade silicon, Czochralski Growing, Silicon shaping, Epitaxy, Molecular beam Epitaxy, Vapour phase Epitaxy, NMOS, CMOS fabrication and BiCMOS Technology.
Current sources, analysis of difference amplifiers with active load, supply and temperature independent biasing techniques, voltage references. Analysis of Operational amplifier circuits, slew rate model and high frequency analysis, operational amplifier noise analysis and low noise operational amplifiers. Analysis of four quadrant and variable transconductance multiplier, voltage controlled oscillator, closed loop analysis of PLL. Design of MOS Operational Amplifier, CMOS voltage references, MOS Power amplifier and analog switches. Design techniques for switched capacitor filter, CMOS switched capacitor filters, MOS integrated active RC Filters.

Text/Reference books:

1.	Basic VLSI Design	Pucknell and Kamran Eshraghian	PHI
2.	Analysis and Design of Analog ICs	Gray and Meyer	Wiley India Pvt Ltd
3.	Principles of CMOS VLSI Design	Neil H E Weste & Kamran Eshraghian	Addison Wesley
4.	VLSI Technology	S M Sze	TMH

5.	Analog MOS Integrated Circuits	Gray, Wooley, Brodersen	IEEE Computer Society Press
6.	Design of Analog Integrated Circuits and Systems	Kenneth R. Laker, Willy M.C. Sansen, William M.C.Sansen	TMH
7.	Principles of Data Conversion System Design	Behzad Razavi	IEEE Computer Society Press

EC 1207 **PROBABILITY AND RANDOM PROCESSES** **L T P C 3-1-0-8**

Pre-requisite- Mathematics

Semester: 4

Probability: Introduction, set definitions, set operators, experimental and sample spaces, discrete and continuous sample space, events, probability definition and axioms, joint probability, conditional probability, total probability, Baye's theorem, two events, multiple events, properties of independent events.
The Random Variable: Introduction, definition of random variable, conditions for a function to be a random variable, discrete and continuous random variables, distribution and density function, Gaussian random variables, conditional distribution and density functions.
Operation on one random variable: Expected value of a random variable, conditional expected value, moments about the origin, central moments, variance and skew, monotonic transformation of a continuous random variables, non-monotonic transformations of a continuous random variables, transformation of a discrete random variables.
Two random variables: Bivariate distributions, joint distribution and density, marginal distribution and density functions, conditional distribution and density, statistical independence, distribution and density of a sum of random variables.
Random processes: Introduction, the random process concept, classification of processes, stationarity and independence, distribution and density functions, statistical independence, first order stationary processes, second order and wide sense stationary, time averages and ergodicity, correlation functions, covariance function.
Spectral characteristics of random processes: Power density spectrum and its properties, bandwidth of the power density spectrum, relationship between power spectrum and autocorrelation function, cross power spectral density and its properties.
Noise: White noise, shot noise, thermal noise, noise equivalent bandwidth.
Random signal response of linear systems: System response-convolution, mean and mean squared value of system response, autocorrelation function of a response, cross-correlation function of input and output, power density spectrum of response, band-pass, band-limited and narrow-band processes.

Text/Reference Books:

1.	Probability, Random Variables & Random Signal Principles	P.Z. Peebles	TMH
2.	Probability, Random variables & Stochastic Processes.	A. Papoulis	TMH
3.	Probability and Stochastic Processes for engineers.	C.W.Helstrom	Macmillan Coll Div
4.	Probability and Random processes for electrical engineers.	A.Leon-Garcia	Pearson Education

EC 1212 **ELECTRONICS LABORATORY II (DEC)** **L T P C 0-0-2-2**

Pre-requisite- EC Lab-I

Semester: 4

LIST OF THE EXPERIMENTS:
1. Study of PIN diagram of various ICs & to test the logic gates and verify their truth table.
2. Implementation of Half adder, Full adder & Half Subtractor using NAND gates only.
3. Implementation of Boolean functions of three and four variables using 74153 (4:1) Mux.
4. To add two 4 bit binary numbers using 7483.
5. To compare two 4 bit binary number using 7485 (magnitude comparator).
6. To verify the operation of different modes of shift Register using 7495.
7. To design an asynchronous counter of any modulus using JK FF's (7473).
8. To design a synchronous counter of any arbitrary count using 7473.

EC 1301 **DIGITAL COMMUNICATION** **L T P C 3-1-0-8**

Pre-requisite- Probability & random process, Signal & System, Analog Communication

Semester: 5

Introduction: A historical perspective in the development of Digital Communication, elements of a digital communication system, analog versus digital communication system.

Pulse modulation: Introduction, quantization process, PCM, DPCM, DM, Adaptive DPCM, sub-band coding, linear predictive coding.

Base band pulse transmission: Introduction, matched filter, error rate due to noise, inter symbol interference, Nyquist's criterion for distortion less base band binary transmission, correlative level coding.

Digital pass-band transmission: Introduction, pass band transmission model, Gram Schmidt orthogonalization procedure, geometric representation of signals, response of bank of correlators, to noisy input, coherent detection of signals in noise, probability of error, correlation receiver, detection of signals with unknown phase, hierarchy of digital modulation techniques, coherent binary PSK, coherent binary FSK, coherent QPSK, coherent minimum shift keying, differential phase shift keying, comparison of binary & quaternary modulation schemes, M-ary modulation techniques, power spectra, bandwidth efficiency, synchronization.

Source coding: Mathematical models of information sources, a logarithmic measure of information, source coding theorem, source coding algorithms- the Huffman source coding algorithm & the Lempel-Ziv source coding.

Channel capacity & coding: Modelling of communication channels, channel capacity, bounds on communication, coding for reliable communication, linear block codes, cyclic codes, convolutional codes, Turbo Codes.

Spread Spectrum and Multiple Access Techniques: Introduction to Spread Spectrum Modulation, Code Acquisition and Tracking, Spread Spectrum as a Multiple Access Techniques

Text Books:

1.	Digital communication	Simon Haykin	John Willey & Sons

Reference Books:

1.	Digital communication	John G Proakis	McGraw Hill
2.	Modern Digital and Analog	B.P.Lathi	Oxford
3.	Communication Systems	Simon Haykin	John Willey & Sons
4.	Introduction to Digital Communication	M.B.Pursley	PHI
5.	Digital and Analog Communication Systems	L.W.Couch	Pearson

EC 1302 **COMPUTER ORGANIZATION AND MICROPROCESSORS** **L T P C 3-0-0-6**

Pre-requisite- Digital Electronics

Semester: 5

Introduction: Fundamental concepts of design methodologies; Basic organization of computer. CPU, address bus, data bus and control bus. Input/Output devices, buffers, encoders, latches and memories. Brief introduction to comparison of different features in 8085 and 8086 microprocessors.

Processor Design: Basic organization; Instruction set; ALU organization; Fixed-point and Floating-point arithmetic.

Controller Design: Basic concepts; Design of Hardwired control and Micro-programmed control units.

Memory Organization: Basic organization; Virtual memory; Memory hierarchical structure; Page, Segment and File concept; Memory interleaving; Cache & Associative memories.

Microprocessor Architecture: Internal Data Operations and Registers, Pins and Signals, Peripheral Devices and Memory Organization, Interrupts.

8085 Microprocessor Instructions: Classification, Format and Timing. Instruction Set. Programming and Debugging, 8 Bit And 16 Bit Instructions.

8085 Microprocessor Interfacing: 8259, 8257, 8255, 8253, 8155 chips and their applications. A/D conversion, memory, keyboard and display interface (8279).

Text/Reference Books:

1.	Computer System Architecture	M.M.Mano	Pearson Education
2.	Digital Design	M.M.Mano	Pearson Education
3.	Computer Architecture and Organization	J.P. Hayes	McGraw-Hill
4.	Computer Organization	V.C. Hamacher, Z.G.Vrasenic, S.G.Zaky	McGraw-Hill
5.	Computer Organization	A.S. Tanenbaum	PHI
6.	Computer Organization and Design	P. Pal Chaudhuri	PHI
7.	Microprocessors- Principles and Applications	Ajit Pal	Tata McGraw-Hill
8.	Microprocessor Architecture, Programming and Applications	S.R. Gaonkar	Penram International Publishing India Pvt Ltd

EC 1303 **INTRODUCTION TO VLSI DESIGN** **L T P C 3-0-0-6**

Pre-requisite- Basic Circuit Analysis, Physics of Semiconductors

Semester: 5

Issues and challenges in Digital IC Design: General overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles.

MOSFET fabrication: Basic steps of fabrication, CMOS p-well and n-well processes, layout design rules, Bi-CMOS fabrication process; Latch-up immune designs.

CMOS Inverter: MOS device model with sub-micron effects, VTC parameters (DC characteristics), CMOS propagation delay, Parasitic capacitance estimation, Layout of an inverter, Switching, Short-circuit and leakage Components of Energy and Power.

Interconnects: Resistance, Capacitance Estimation, delays, Buffer chains, Low swing drivers, Power distribution, and performance optimization of digital circuits by logical effort sizing.

Combinational logic design: Static CMOS construction, Ratioed logic, Pass transistor, Transmission gate logic, DCVSL, Dynamic logic design considerations, Noise considerations in dynamic design, Power dissipation in CMOS logic, Domino and NORA designs.

Sequential circuits design: Classification, Parameters, Static latches and register, Race condition, Dynamic latches and registers, Two phase vs. Single phase clock designs, Pulse based registers; Design of arithmetic building blocks like adders (static, dynamic, Manchester carry-chain, look-ahead, linear and square-root carry-select, carry bypass and pipelined adders) and multipliers (serial - parallel, Booth's and systolic array multipliers (optional)).

Semiconductor memories: Non-volatile and volatile memory devices, flash memories, SRAM cell design, Differential sense amplifiers, DRAM design, Single ended sense amplifier.

Testing in VLSI: Defects, Fault models, Path sensitization, Scan, Built-in-self Test (BIST), IDDQ.

Text/Reference books:

1.	Digital Integrated Circuits- A Design Perspective	J.M. Rabaey, A. Chandrakasan and B. Nikolic	PHI,2003, 2/e
2.	CMOS VLSI Design: A Circuits and Systems Perspective	N. Weste and D. Harris	Pearson,2010,4/e
3.	Analysis and Design of Digital Integrated Circuits in Deep submicron Technology	D. A. Hodges, H. G. Jackson, and R. Saleh	TMH,2003,3/e
4.	CMOS Digital Integrated Circuits Analysis and Design	S.Kang and Y.Leblebici	TMH ,2002,3/e
5.	Introduction to VLSI Circuits and Systems	J. P. Uyemura	Wiley India Pvt Ltd,2001,1/e
6.	Modern VLSI Design - System on Chip design	W. Wolf	PHI,2002, 3/e

EC 1304 **ELECTRO MAGNETIC FIELD THEORY AND WAVE PROPAGATION** **L T P C 3-1-0-8**

Pre-requisite- Vector Calculus, Engineering Mathematics

Semester: 5

Vector calculus: Cartesian, Cylindrical and spherical co-ordinate systems, differential lengths, surfaces and volumes.

Electrostatics: Coulomb's law, Electric field, intensity, electric flux density, Gauss's law and applications, divergence and divergence theorem, potential difference and potential gradient, Electric dipole and dipole moment, Energy in electric field.

Steady magnetic fields: Biot Savart's law, Amperes circuital law and application, Curl and Stroke's theorems, Magnetic flux density and magnetic flux, scalar and vector magnetic potentials

Maxwell's equations and time varying fields, Faraday's law, displacement current, Maxwell's Equations in point & integral form, Retarded potentials, Uniform Plane waves: Maxwell's equation in phasor form, wave equation in general medium and perfect dielectric mediums, Solution of wave equations, intrinsic impedance, velocity and wavelength, conductors and dielectrics, depth of penetration, Poynting's vector theorem.

Reflection of Electromagnetic Waves: Reflection of Electromagnetic waves: Normal incidence, standing waves, laws of reflection, reflection of obliquely incident waves, Brewster's angle.

Different modes of Radio Wave Propagation: Ground Wave Propagation, Tilt, Sky Wave Propagation, MUF, Skip Distance, Critical Frequency, Virtual Height.

Space Wave Propagation, Modified Refractive Index, Its effects on wavepropagation, Propagation over Plane Earth and spherical earth, Anomalous Propagation, Diffraction, Duct Propagation, Troposphere Propagation.

Text/Reference Books:

1.	Microwave Engineering	Pozar	Wiley
2.	Foundation for microwave engineering	RE Collin	Wiley
3.	Microwave and Radar Engineering	A.K.Gautam	S. K. Kataria & Sons
4.	Microwave Devices and Circuits	Liao	Pearson
5.	Microwave Passive Circuits	Rizzi	PHI

EC 1311 **ELECTRONICS LABORATORY III (MICROPROCESSORS AND MICROCONTROLLERS)** **L T P C 0-0-2-2**

Pre-requisite- Digital Electronics, Microprocessor Theory

Semester: 5

LIST OF THE EXPERIMENTS:

8085:

1. Familiarization with the Microprocessor kit.
2. To move one block of data from one location to another
3. a. Addition of two numbers
   b. Addition of two BCD numbers
   c. Addition of N number of one byte numbers
4. Subtraction one byte from another byte for all the cases
5. a. Multiplication of two bytes using successive addition
   b. Multiplication by shift and add method.
6. a. To find the smallest number from the block of data
   b. To arrange the numbers of data in descending order
7. To control the speed of and direction of stepper motor
8. To interface LED matrix

8086:

1. First three problems using 8086

8051:

1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.

2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable).
3. Simple Calculator using 6 digit seven segment display and Hex Keyboard interface to 8051.
4. Alphanumeric LCD panel and Hex keypad input interface to 8051.

EC 1312 **ELECTRONICS LABORATORY IV (VLSI)** **L T P C 0- 0- 2- 2**

Pre-requisite- VLSI Theory

Semester: 5

LIST OF THE EXPERIMENTS:

1. Static characteristics of an inverter in schematic.
2. Static characteristics of two input NAND gate, two input NOR gate, two input AND gate, two input OR gate in schematic.
3. Static characteristics of inverter in layout.
4. Transfer and transient characteristics of two input NAND gate, two input OR gate, two input AND gate and two input NOR gate in layout.
5. Realize a 2-input EXOR gate in schematic and draw its layout and simulate.
6. Realize a 1-bit full adder in CMOS schematic and simulate. Generate layout using tool option and simulate.
7. Realize a Boolean expression y=NOT ((A+B) (C+D) E) in schematic and draw its layout and simulate.
8. 4 x 1 MUX using transmission gates in schematic and layout and simulate.
9. D Flip-Flop, JK Flip-Flop and T Flip-Flop in CMOS schematic and layout.
10. Four bit asynchronous counter using T Flip-Flop as a cell in schematic.
11. Four bit synchronous counter using T Flip-Flop as a cell in schematic.
12. Four bit shift register using D Flip-Flop as a cell in schematic

EC 1313 **ELECTRONICS LABORATORY V (COMMUNICATION ENGINEERING)** **L T P C 0-0-2-2**

Pre-requisite- Analog & Digital Communication

Semester: 5

LIST OF THE EXPERIMENTS:

1. Experiment of Modulation Demodulation Techniques on (a) AM (b) DSB-SC (c) SSB-SC (d) FM
2. Experiment on analog Pulse modulation such as PAM, PWM
3. Experiment of modulation and demodulation techniques of PCM.
4. Experiment on TDM-PCM system.
5. Experiment of generation and reconstruction of ASK, FSK, PSK, QPSK.
6. Experiment on channel/source coding.
7. Any innovative or established design of communication*(analog/digital) circuit/logic through ASIC /reconfigurable board.

EC 1306 **DIGITAL SIGNAL PROCESSING** **L T P C 3-0-0-6**

Pre-requisite- Signals and Systems, Mathematics

Semester: 6

Review of discrete time signals and systems: Linearity, causality, stability, discrete time Fourier transform, sampling and z-transform.
*Structures for Discrete-time Systems***:** Block diagram representation of linear constant coefficient difference equations - their interconnection schemes, direct form-I, direct form-II, cascade form and parallel form structures, Finite word-length effect-number representation, analysis of effect of coefficient quantization and rounding of noise, zero input limit cycles in fixed-point realizations of IIR digital filters.
Discrete Fourier Transforms and other transforms: Frequency domain sampling; the DFT and properties of DFT, circular convolution; linear convolution using DFT. Computational complexity, FFT algorithms - the decimation-in-time and decimation-in-frequency, signal flow graph-Butterfly computations, in-place computations; analysis of computational complexity, other transforms such as DCT, Haar and Walsh Hadmard transform.
Filter Design Techniques: Characteristics of practical frequency selective filter, design of FIR filters by windowing, Characteristics of Butterworth & Chebyshev filters, frequency transformation, design of IIR filters from continuous-time filters, Impulse invariance & bilinear transformation methods, MATLAB based examples.
*Multirate DSP:*Introduction to multirate DSP, decimation and interpolation, polyphase decomposition, uniform DFT filter banks, quadrature mirror filters and perfect reconstruction.
Multiresolution Analysis: Introduction to multiresolution analysis, discrete wavelet transforms.

Text/Reference Books:

1.	Digital Signal Processing : Principles, Algorithms And Applications	J. G. Proakis and D.K. Manolakis	Prentice Hall India, New Delhi, 4th Edition 2006
2.	Discrete-Time Signal Processing	Alan V. Oppenheim and Ronald W. Schafer	Prentice Hall India, New Delhi, 3rd Edition, 2009.
3.	Digital Signal Processing	Sanjit K. Mitra	Tata McGraw Hill, 3rd Edition, 2006
4.	Theory and Application of Digital Signal Processing	L. R. Rabiner and B. Gold	Prentice Hall of India, 2005
5.	Digital Filters: Analysis, Design and Applications	A. Antoniou	Tata McGraw Hill, New Delhi, 2003
6.	Digital Signal with MATLAB	V. K. Ingle and J. G. Proakis	Cenage Learning, 2008
7.	Digital Signal Processing	E. C. Ifeachor and B. W. Jervis	Pearson Education, 2005
8.	Digital Signal Processing	T. J. Cavicchi	John Wiley and Sons, Inc. Singapore, 2002

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EC 1307 **DATA COMMUNICATION AND NETWORKS** **3-0-0-6**

Pre-requisite- Analog Communication, Digital Communication, Digital Electronics

Semester: 6

Overview of data communication and Networking: Data communications components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, internet today; Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Physical layer: Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & non-guided);

Review of data transmission principles, transmission components; Different line coding techniques, digital carrier modulation techniques: ASK, PSK, QPSK, QAM, M*ary digital modulation; data compression techniques, TDM, FDM, WDM; Circuit switching: time division & space division switch, Packet switching.

Data link layer: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control, Protocols: Stop & wait ARQ, Go-Back-NARQ Selective repeat ARQ, HDLC;

Point to point protocol, token bus, token ring, Reservation, polling

Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, fast Ethernet;

Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: Internet address, classful address, subnetting; Routing: techniques, static vs. dynamic routing, routing table for classful address;

Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.

Transport layer: Process to process delivery; UDP; TCP; Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm.

Application layer: DNS; SMTP, SNMP, FTP, HTTP & WWW; Introduction to Network Security: introduction to Cryptography, Data Encryption standard, RSA Algorithm, Digital signature, public keys, IPSec.

Text/Reference Books:

1.	Computer Networks	A.S.Tanenbaum	Pearson Education/PHI, 4th Ed.
2.	Data and Computer Communications	W. Stallings	PHI/Pearson Education, 5th Ed.
3.	Network for Computer Scientists & Engineers	Zheng & Akhtar	OUP
4.	Data Communications and Networking	B.A. Forouzan	TMH, 3rd Ed.
5.	Data & Computer Communication	Black	PHI

Reference Books:

1.	Data Communication & Network	Miller	Vikas
2.	Digital & Data Communication	Miller	Jaico
3.	Understanding Data Communication & Network	Shay	Vikas
4.	Computer Networking +A top down approach featuring the internet	Kurose and Rose	Pearson Education
5.	Communication Networks	Leon, Garica, Widjaja	TMH
6.	Communication Networks	Walrand	TMH
7.	InternetworkingwithTCP/IP,vol.1,2,3	Comer	Pearson Education/PHI, 4th Ed.

EC 1308 **RF AND MICROWAVE ENGINEERING** **L T P C 3-0-0-6**

Pre-requisite- Electromagnetic Field Theory and Maxwell Equations

Semester: 6

Introduction: RF & Microwave Spectrum. Historical Background. Typical applications of RF & Microwaves.
Transmission lines and Waveguides: Circuit model for transmission lines, loss less and lossy lines, field analysis of transmission lines, Smith chart, impedance matching. Rectangular and Circular Waveguides. Node structures, Cut-off frequency, Propagation characteristics, Wall current, Attenuation constant, Waveguide excitations.
Waveguide Passive Components: Waveguide Resonators-Rectangular & Cylindrical; Resonant frequencies, Mode structures, Q factor, Co-axial Resonators; Excitation & Coupling of cavities, Design of resonators. N-port networks – circuit representations, Z – matrix, Y – matrix, S – matrix, transmission matrix; their relationships; Attenuators, Phase shifter, Directional couplers, Bethe-hole coupler, Magic Tee, Hybrid ring, Circulators, Isolators.
Microwave Tubes: Limitations of conventional tubes in microwaves; Multi cavity Klystron, Reflex Klystron; Magnetron; Travelling Wave Tube; Backward Wave Oscillator- working principles, characteristics.
Semiconductor Microwave Devices: Tunnel diode, Gunn diode, IMPATT diode, TRAPATT diode, Microwave bipolar Transistor, hetero junction bipolar transistor, Microwave field effect transistor.
Planar Structures: Strip Lines: Microstrip lines, coplanar structures, Slot lines, Suspended strip lines, Fin lines – configurations, Field patterns, propagation characteristics, Design considerations. Comparison of characteristics of lines.
Basic Microwave Measurements: Measurement of frequency, impedance, SWR and Power.

Text/Reference Books:

1.	Microwave Engineering	Pozar	Wiley India Pvt Ltd
2.	Foundation for microwave engineering	RE Collin	Wiley India Pvt Ltd
3.	Microwave and Radar Engineering	A.K.Gautam	S. K. Kataria & Sons
4.	Microwave Devices and Circuits	Liao	Pearson
5.	Microwave Passive Circuits	Rizzi	PHI

EC 1309 **MEASUREMENT AND INSTRUMENTATION** **L T P C 3-1-0-8**

Pre-requisite- Basic Electrical & Electronics Engineering

Semester: 6

Concept of Measurement: Errors in measurement: Systematic errors & Random errors- errors analysis, performance characteristics & functional description of instrumentation system: zero order, First & second order Instruments.
Electronic Instruments: Electronic Voltmeter , Electronic multi meter , Electronic ohm-meter , chopper stabilized amplifier , Q- meter , Wave Analyzers , Spectrum Analyzers.
Electronic Test Equipments & Display Devices: CRO, Frequency meter, data loggers, digital read out systems, Magnetic tape Recorder.
Signal conditioning system: Instrumentation Amplifier, Isolation Amplifier, DAC & ADC, Multiplexers, Sample & Hold Circuits.
Transducers: Measurements of displacement, strain, pressure, flow, temperature, force.
Actuators: Solenoid valve, Stepper motor, relays.

Text/Reference books:

1.	Principle of Industrial Instrumentation	D. Patranabis	TMH
2.	Transducer and Instrumentation	D.V.S Murty	PHI

EC 1310 **CONTROL SYSTEM** **L T P C 3-1-0-8**

Pre-requisite- Mathematics, Signal & System

Semester: 6

Introduction to Automatic Control: Basic elements of control systems, Functional block diagram of a control system. Control terminology, Open loop and closed loop control systems, examples of automatic control systems. Basic elements of a servo machines.
The Control Problem: Models of physical systems, differential equations, transfer functions and state variable models of simple control components, block diagrams and reduction technique, transfer functions of physical systems, signal flow graph and Mason's gain formula.
Control System Characteristics: Standard test signals, Order of systems, concepts of time constant, Dynamic characteristics of systems, Linear and non-linear systems, step response of first order and second order systems – overshoot and undershoot, damping ratio, Steady state response and error. Stability, sensitivity and disturbance rejection and steady-state accuracy. Characteristic equation, Routh's stability criteria. Relative stability indices – phase margin and gain margin , root locus analysis, frequency response plots: Bode plots and Nyquist stability criterion.
Design of Control System: Classical design – root locus and frequency response based design for phase-lead, phase-lag and PID controllers, Modern design: pole placement design, controllability and observability.
Introduction to Advanced Control Systems: Introduction to Digital control system , adaptive control, Fuzzy Logic control, Neural Control, Neuro-Fuzzy control.

Text/ Reference books:

1.	Modern Control Engineering	K. Ogata	Prentice Hall India
2.	Control System	M.Gopal	Tata McGraw Hill
3.	Automatic Control Systems	Benjamin C. Kuo	Prentice-Hall Inc.

EC 1314 **DESIGN LABORATORY** **L T P C 0-0-2-2**

Pre-requisite-Microprocessor, Analog, Digital, Communication

Semester: 6

A student has to do an electronic hardware mini-project in broad areas like communication, electronic systems design, control and instrumentation, computer, power systems and signal processing. The project involves laying down the specifications, design, prototyping and testing. The project must have major hardware modules involving active discrete components and integrated circuits.

Text/Reference books:

1.	Digital Design	M. M. Mano	Pearson
2.	Art of Electronics	P. Horowitz and W. Hill	Cambridge University Press
3.	Analysis and Design of Digital Integrated Circuits in Deep submicron Technology	D. A. Hodges, H. G. Jackson, and R. Saleh	TMH
4.	The ARRL Handbook for Radio Communications		American Radio Relay League
5.	Electronic Instruments Handbook	C. F. Coombs	TMH
6.	The Circuit Designer's Companion	T. Williams	Newnes
7.	Trouble shooting Analog Circuits	R. Pease	Elsevier

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EC 1315 **ELECTRONICS LABORATORY VI (CONTROL SYSTEM)** **0-0-2-2**

Pre-requisite-Signal & System, Mathematics

Semester: 6

LIST OF THE EXPERIMENTS:

1. Familiarization with MATLAB Control System tool Box, MATLAB- SIMULINK tool box
2. Determination of step response for 1st order & 2nd order system & calculation of control system specifications for variations of system design using MATLAB
3. Simulation of step response & impulse response for Type-I & Type-II system with unity feedback using MATLAB.
4. Determination of root locus, Bode-plot, Nyquist Plot, using MATLAB control system toolbox for a given 2nd order transfer function & determination of different control system specifications.
5. Determination of PI, PD, and PID controller action on 1^{st} order simulated process
6. Determination of approximate transfer function experimentally using Bode Plot
7. Evaluation of steady-state error, setting time, percentage peak, overshoots, gain margin, phase margin with addition of lead compensator in forward path transfer functions using MATLAB.
8. Stability analysis of linear system
9. Determination of transfer functions of nonlinear dynamic system using Simulink

EC 1316 **ELECTRONICS LABORATORY VII (DSP)** **L T P C**
0-0- 2- 2

Pre-requisite- DSP Theory, MATLAB

Semester: 6

LIST OF THE EXPERIMENTS:

1. Familiarization with Code Composer Studio & DSP 6713 & DSP 6416 Kit
2. Wave form generation (Sine Wave, Triangular wave, Stair case wave form etc.)
3. Sampling and sampling rate conversion with Code Composer Studio & DSP 6713 & DSP 6416 Kit
4. Quantization with Code Composer Studio & DSP 6713 & DSP 6416 Kit
5. Implementation of Second order IIR Filter (Biquad) in DSP kit board.
6. Implementation of Notch Filter (Single notch filter, Multi notch filter) in DSP kit board.
7. Implementation of FIR FILTER in DSP kit board.
8. Implementation of Graphic Equalizer in DSP kit board.
9. Implementation of Frequency Analyzer in DSP kit board.
10. Implementation of BPSK Modulator in DSP kit board.
11. Implementation of Harmonic Retrieval in DSP kit board.
12. Implementation of FSK Modulator in DSP kit board.
13. Implementation of Carrier Recovery in DSP kit board.
14. Implementation of AM & FM in DSP kit board.
15. Implementation of Antipodal Modulation (Manchester Code) in DSP kit board.

EC 1401 **PRINCIPLE OF OPTO-ELECTRONICS AND FIBRE OPTICS** **L T P C 3-0-0-6**

Pre-requisite- Physics of Semiconductor, Electromagnetic field, Communication Theory

Semester: 7

Introduction: Brief introduction to opto-electronics and optical communication, advantages of optical communication.
Optical fiber waveguides: Ray theory transmission, Electromagnetic mode theory for optical propagation, Cylindrical fiber, Single Mode fibers.
Transmission characteristics of optical fibers: Attenuation, Material absorption losses in silica glass fiber, linear scattering losses, Rayleigh scattering, Chromatic dispersion, Intermodal dispersion, Overall fiber dispersion, Dispersion modified Single mode fibers, Polarization.
Optical fibers and cables: Preparation of optical fibers, liquid phase techniques, fiber drawing, Vapor-phase deposition techniques, Optical fiber cable.
Optical fiber connections: joints, couplers and isolators: Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers, Optical isolators and circulators.
Optical Sources 1: the laser
Basic concepts: absorption and emission of radiation, the Einstein relations, population inversion, optical feedback and laser oscillation, threshold condition for laser oscillation.
Optical emission from semiconductors, The semiconductor injection laser, Some injection laser structures, Injection laser characteristics, Non semiconductor lasers: The Nd:YAG laser, glass fiber laser.
Optical Sources 1: the LED
LED power and efficiency, LED structures, LED, Modulation and problems
Optical Detectors: Device types, optical detection principles, Absorption, III-V alloys, Quantum efficiency, Responsivity, Long wavelength cut-off, Semiconductor photodiodes without internal gain: p-n photodiode, p-i-n photodiode speed of response and travelling wave photodiode, Noise.
Semiconductor photodiodes with internal gain, mid infrared and far infrared photodiode, phototransistors, metal semiconductor-metal photodetectors, problems.
Direct detection receiver performance considerations: Noise: Thermal noise, dark current noise, quantum noise, digital signaling quantum noise, analog signaling transmission quantum noise.
Receiver noise: p-n and p-i-n photodiode receiver, APD, Gain bandwidth product
FET amplifiers: GaAs MESFETs, PIN-FET hybrid receivers, problems.
Optical amplification, wavelength conversion and regeneration: Optical amplifiers, fiber and waveguide amplifiers, wavelength conversion, optical regeneration and problems.
Optical fiber system-I: IM-DD system: optical transmitter circuit, optical receiver circuit, system design consideration, digital system planning consideration, regenerative repeater, channel losses, temporal response, power budgeting, line coding.
Analog system: D-IM, SCM, SCMDSB-IM, SCM FM-IM, SCM PM-IM.
Optical fiber system 2: coherent
Basic system, detection principle, practical constraint, demodulation, schemes, receiver sensitivities of ASK, FSK, PSK heterodyne detection, ASK and PASK homodyne detection, Comparison of sensitivities, WDM system.
Basic concepts on optical networks.

Text Books:

1.	Optical Fiber communications	J.M.Senior	PEARSON

Reference Books:

1.	Optoelectronics: An Introduction 2nd edition	Wilson & Hawkes	PHI
2.	An Introduction to fiber optics	Shotwell	PHI
3.	Semiconductor Optoelectronic devices	P. Bhattecharjee	PHI
4.	Fiber-Optic Communication Systems	G. P. Agrawal	John Wiley & Sons
5.	Optical Networks	R.Ramaswami	Elsevier

L T P C

EC 1402 **POWER ELECTRONICS** **3-0-0-6**

Pre-requisite- Signal & System, Physics of semiconductor, Digital Electronics, Basic Electrical Engineering.

Semester: 7

Power Semiconductor devices: Diodes, BJT, MOSFET, SCR, Triacs, GTOs, IGBT and MCT - static characteristics, ratings, driver circuits and principles of operation; protection and cooling.
AC-DC converters (Rectifiers): Diode rectifier, phase control rectifiers; effect of source inductance, single/three phase rectifiers, semi/full rectifiers, power factor, harmonics.
DC-AC converters (inverters): Concept of switched mode inverters, PWM switching, voltage and frequency control of single/three phase inverters, harmonics reduction, other switching schemes-square wave pulse switching, programmed harmonic elimination switching, current regulated modulation switching- tolerance band control, fixed frequency control, voltage source inverter (VSI),current source inverter(CSI).

DC-DC Converter (Chopper): Principle, buck, boost and buck-boost converters;
AC voltage controllers: Principle of ON-OFF control and phase control, single/three phase controllers, PWM AC voltage controller.
Basic concepts of adjustable speed dc and ac drives and industrial application.

Text/Reference books:

1.	Power Electronics- Converters, Application and Design	N. Mohan	John Wiley& Sons
2.	Fundamentals of Electrical Drives	G.K Dubey	Narosa Publishing House
3.	Power Electronics-circuits, Devices and applications	Muhammmad Rashid	Prentice Hall
4.	Modern Power Electronics and AC Drives	B.K Bose	Pearson Education
5.	Introduction to Modern Power Electronics	Andrej M.Trzynadlowski	John Wiley & Sons
6.	Power Electronics Handbook	Muhammad Rashid	Academic Press-Elsevier

ADVANCED MICROPROCESSORS (Elective I) **L T P C**

EC1421 **3-0-0-6**

Pre-requisite- Microprocessor, Digital Electronics

Semester: 8

Introduction to Microprocessor: RISC & CISC processor, Vector Processor, Array Processor, Von Neuman Architecture of computer, Harvard Architecture of computers, Data flow Architecture.
16 Bit Microprocessor (Intel 8086): Pin description, operating modes, Register Organization. Bus Interface & Execution unit, interrupts, 8086 Read &Write Bus cycles, Lock, Addressing modes.
Instruction set of Intel 8086:
32 Bit Microprocessor (Intel 486): 486DX Architecture, Register Organization of 486 Microprocessor, Memory organization, Description, GDT, LDT &IDT , operating modes of Intel 486 , Virtual Memory, Memory management unit, Interrupts & Exceptions, Addressing modes of 80486, Pin configuration & signals of 80486.
Input/Output devices & supporting chips: Intel 82489DX, Advanced programmable Interrupt controller (APIC), Intel 82093AA, I/O Advanced Programmable Interrupt Controller (IOAPIC); Intel 82357, Integrated system Peripheral (ISP).
Other Microprocessor: Power PC Microprocessor, Pentium Processor (Pentium I, II, and III & IV), Pentium Pro Processor, and Sun's SPARC Microprocessor.
Introduction to Microcontroller: Microprocessor V/S Microcontroller, Types of Microcontrollers , Processor Architecture , Microcontroller Memory types ,Micro controller Features- clocking, I/O pins, Interrupts, Timers, Peripherals.
8051 Architecture: Architecture, memory organization, addressing modes, Memory Organization & External Addressing, Interrupts, 8051 Instruction Set & Execution of Instruction.

Texts/ References books:

1.	Advanced Microprocessor & Microcontroller	S.K Venkata Ram	University Science Press
2.	Advanced Mcroprocessor & Interfacing	Badri Ram	TMH
3.	The Pentium Microprocessor	Antonakos	Pearson

EC 1422 **OPTICAL COMMUNICATION NETWORKS (Elective I)** **L T P C 3-0-0-6**

Pre-requisite- Opto Electronics, Computer Networks

Introduction to optical networks: Telecommunication network architecture, services, circuit switching, and packet switching, optical networks, the optical layer, transparency and all-optical networks, optical packet switching, transmission basics, network evolution.

I. Technology:

Propagation of signals in optical fiber: Light propagation in optical fiber, loss and bandwidth, chromatic dispersion, nonlinear effects, solitons and problems.

Components: Couplers, isolators and circulators, multiplexers and filters, optical amplifiers, transmitters, detectors, switches, wavelength converters and problems.

Modulation and Demodulation: Modulation, Subcarrier modulation and multiplexing, spectral efficiency, demodulation, error detection and corrections and problems.

Transmission system engineering: System model, power penalty, transmitter, receiver, optical amplifier, crosstalk, dispersion, fiber nonlinearities, wavelength stabilization, design of soliton systems, design of dispersion managed soliton system, overall design considerations and problems.

II. Networks:

Client layers of the optical layer: SONET/SDH, Multiplexing, SONET/SDH layers, SONET frame structures, SONET/SDH physical layers ATM, IP, storage area networks, ESCON, HIPPI and problems.

WDM Network elements: Optical line terminals, optical line amplifiers, optical add/drop multiplexers, optical crossconnects and problems.

WDM Network Design: Cost trade-offs: A detailed ring network example, LTD and RWA problems, Dimensioning Wavelength-Routing networks, statistical dimensioning models, maximum load dimensioning models and problems.

Control and Management: Optical layer services and interfacing, layers within the optical layer, multivendor interoperability, performance and fault management, configuration management and problems.

Network Survivability: Basic concepts, protection in SONET/SDH, protection in IP networks, why optical layer protection, optical layer protection scheme, internetworking between layers and problems.

Access Networks: Network architecture overview, enhanced HFC, FTTC and problems.

Photonic packet switching: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, testbeds and problems.

Development Consideration: The evolving telecommunications network, designing the transmission layer (using TDM, SDM, WDM), unidirectional versus bidirectional WDM systems.

Text Books:

1.	Optical Networks	R.Ramaswami, K.N.Sivarajan	Elsevier

References Books:

1.	Optical Communication System	J.Gower	Prentice Hall of India
2.	Optical Fiber Communication	John M. Senior	Pearson Education
3.	Optical Fiber Communication	Gerd Keiser	Mc Graw Hill
4.	Optical Networks	Rajiv Ramaswami	Elsevier
5.	Fiber-optic communication systems	Govind P. Agrawal	John Wiley & sons
6.	Fiber Optics and Optoelectronics	R.P. Khare	Oxford University Press

EC 1423 **DIGITAL IMAGE PROCESSING (Elective I)** **L T P C 3-0-0-6**

Pre-requisite- Digital Signal Processing

Digital image fundamentals: Visual perception, image sensing and acquisition, sampling and quantization, basic relationship between pixels and their neighborhood properties.

Image Transformation: 2D DFT, DCT, Walsh-Hadamard transform, KLT, Harr transform and discrete wavelet transform.

Image enhancement in spatial domain: Fundamental concepts, enhancement by point processing, Gray-level transformations, histogram processing, spatial filters- averaging, order statistics; image sharpening.

Image filtering in frequency domain: Fundamental concepts, Smoothing and sharpening filtering in frequency domain, homomorphic filtering;

Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering.

Image compression: Lossy and lossless compression, entropy coding, transform coding, image coding standards.
Image analysis: edge and line detection, segmentation, feature extraction, classification; image texture analysis.
Morphological Image Processing: Basic operations- dilation, erosion, opening, closing, Hit-Miss transformations, Basic morphological algorithms and applications.
Color image processing: Color models RGB, HSI, YUV, pseudo-color image processing, full-color image processing, color transformation, color segmentation.

Texts/References Books:

1.	Fundamentals of Digital Image processing	A. K. Jain	Pearson Education, 1989
2.	Digital Image Processing	R. C. Gonzalez and R. E. Woods	Pearson Education, 2001
3.	Digital Image Processing using MATLAB	R. C. Gonzalez , R. E. Woods and S. L. Eddins	Pearson Education, 2004
4.	Digital Image Processing	G. A. Baxes	John Wiley, 1994
5.	Digital Image Processing and Computer Vision	R.J. Schalkoff	John Wiley, 1989
6.	Image Processing	Sid Ahmed	McGraw -Hill, 1994
7.	S.J. Solari	Digital Video and Audio Compression	McGraw-Hill, 1996

EC 1424 **SATELLITE COMMUNICATION (Elective I)** **L T P C 3-0-0-6**

Pre-requisite- Some background in electromagnetics and basic signal processing. Elective work in antennas and digital communications is often helpful.

Introduction to Satellites and Their Applications: Introduction to satellite, History of Evolution of Satellites, Applications, Evolution of Launch vehicles, Future Trends.
Orbital Aspects: Orbit and Trajectory, Basic Principles of Orbiting Satellites, Orbital Mechanics, Orbital Parameters, Injection Velocity and Resulting Satellite Trajectories, Types of Orbits.
Satellite Launch and In-orbit Operations: Acquiring the Desired Orbit, Satellite Launch Sequence, Orbital Perturbations, Satellite Stabilization, Orbital Effects on Satellite's Performance, Eclipses, Sun Transit Outage, Looks Angles of a Satellite, Earth Coverage and Ground Tracks.
Satellite Hardware and Subsystems: Various Satellite Subsystems, Attitude and Orbit Control, Tracking, Telemetry and Command Subsystem, payload, Antenna Subsystems.
Satellite Link Design Fundamentals: Transmission Equation, Link Parameters, Link Calculations, C/N, G/T, EIRP, Back-off Calculation.
Earth Station: Types of Earth Station, Architecture, Design Considerations, Earth Station Hardware, Satellite Tracking.
Communication Techniques: Amplitude Modulation, Frequency Modulation, Pulse Communication Systems, Sampling Theorem, Digital Modulation Techniques-ASK, FSK, PSK, DPSK, QPSK, Offset QPSK; Multiplexing Techniques-FDM, TDM, OFDM, Spread Spectrum Techniques, Multiple Beam, Spot Beam.
Multiple Access Techniques: Introduction, FDMA, SCPC Systems, MCPC Systems, TDMA, TDMA Burst, TDMA Frame Structure, Unique Word, Frame Efficiency, Frame Acquisition and Synchronization, FDMA vs. TDMA, CDMA, SDMA.
Recent Trends: Applications, Challenges of Transponders, VSATS, DTH Television, Satellite Telephony, Satellite Radio.

Texts/References Books:

1.	Satellite Communications	Dennis Roddy	TMH
2.	Satellite Communications	Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt	Wiley India Pvt Ltd.
3.	Digital Satellite Communication	T.T.Ha	MHE
4.	Satellite Communications	Maini & Agrawal	Wiley India Pvt Ltd

EC 1425 **INFORMATION THEORY, CODING AND CRYPTOGRAPHY (Elective I)** **L T P C 3-0-0-6**

Pre-requisite-Digital Communication, Probability theory & Random Process

Source Coding: Uncertainty and information, average mutual information and entropy, information measures for Continuous random variables, source coding theorem, Huffman codes.
Channel Capacity And Coding: Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.
Linear And Block Codes For Error Correction: Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.
Cyclic Codes: Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.
BCH Code: Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.
Convolutional Codes: Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes(Viterbi Decoding), distance and performance bounds for convolutional codes, examples of convolutional codes.
Introduction to Turbo coding: Turbo coding, turbo decoding.

Introduction to Cryptography: Introduction, overview of Encryption techniques, operation used by Encryption Algorithms, symmetric cryptography, data encryption standard, international data encryption algorithm, RC ciphers, asymmetric algorithms, the RSA algorithm, Pretty Good Privacy, One-Way hashing, Diffie-Hellman key agreement protocol, quantum cryptography.

Texts/References Books:

1.	Elements of Information Theory	T.M.Cover and J.A.Thomas	Wiley Student Edition
2.	Information theory, coding and cryptography	Ranjan Bose	TMH
3.	Error Control Coding	Shu Lin and D J Costello Jr	Prentice Hall
4.	Information and Coding	N Abramson	McGraw Hill
5.	Introduction to Information Theory	M Mansurpur	McGraw Hill
6.	Information Theory	R B Ash	Prentice Hall

EC 1426 **BIOMEDICAL INSTRUMENTATION (Elective I)** **L T P C 3-0-0-6**

Pre-requisite- Advanced Electronic Circuits, DSP, Measurement & Instrumentation.

Introduction, Biometrics, physiological systems of the body, sources of bioelectric signals, propagation of action potential.
Transducer classification, selecting of transducers, circuit based on transduction, temperature transducers, displacement transducer, pressure transducer, catheter tip transducer, piezoelectric transducer and their applications.
Electrode: Theory, electrode-tissue interface, microelectrodes, needle electrode, electrodes for ECG, EEG and EMG, motion artifacts, silver-silver chloride electrodes, electrical connectivity of electrode jellies and creams.
Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram(EMG), Electroculogram (EOG), Electroretinogram (ERG).
Biosensors Chemoreceptors, hot and cold receptors, baro receptors, sensor for smell, sound, vision, osmolality and taste.
Cardiac pacemaker- types, working principle and performance
X-RAY, fluoroscopy, computed tomography, Principles of sectional imaging
Physics of ultrasound, Doppler, Magnetic Resonance Imaging, Principles of MRI, MRI Instrument, functional MRI, Application of MRI, Introduction to fusion imaging

Texts/References Books:

1.	Biomedical Instrumentation Technology and applications	R.S. Khandpur	McGraw Hill
2.	Biomedical Instrumentation and Measurements	Hestive Cromwell, Fred J. Weibell and Erich A. Pfeiffer	PHI
3.	Medical Instrumentation, Application and Design	John G. Webster	John Willey and Sons

EC 1427 **BIOMEDICAL SIGNAL PROCESSING (Elective I)** **L T P C 3-0-0-6**

Pre-requisite-DSP, Signal & System, Signal Processing.

Discrete and continuous Random variables, Probability distribution and density functions. Gaussian and Rayleigh density functions, Correlation between random variables.
Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems.
Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Hoffman coding, vector quantisation, DCT and the K L transform.

Cardiological Signal Processing: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia detection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis.

Adaptive Noise Canceling: Principles of Adaptive Noise Canceling. Adaptive Noise Canceling with the LMS adaptation Algorithm. Noise Canceling Method to Enhance ECG Monitoring. Fetal ECG Monitoring.

Signal Averaging method: Linear prediction & other optimization methods.

Neurological Signal Processing: Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.

Text Books:

1.	Biomedical Signal Analysis	Rangaraj M. Rangayyan	IEEE Press
2.	Biomedical Signal Processing- principles and techniques	D.C.Reddy	Tata McGraw-Hill
3.	Biomedical Digital Signal Processing	Willis J.Tompkins	PHI

Reference Books:

1.	Digital Bio signal Processing	R .Weitkunat	Elsevier
2.	Biomedical Signal Processing	M. Akay	Academic: Press
3.	Biomedical Signal Processing -Vol. I Time & Frequency Analysis	A . Cohen	CRC Press

EC 1428 **EMBEDDED SYSTEMS (Elective-I)** **L T P C 3-0-0-6**

Pre-requisite- Microprocessor & Microcontroller, Computer Organization & Architecture

Introduction to Embedded Systems: What is an embedded system? Basic architecture of an embedded system. Some embedded systems around us. General characteristics of embedded systems, Concept of real time systems, Classification of embedded systems, Challenges in embedded system design.
Embedded Systems Processors: Custom single purpose processor design – FSM method, FSMD method, HPL method and ASM chart method.
Embedded System Peripherals: Timers, Counters and Watchdog timers, UART, PWM, LCD Controllers, Keypad Controllers, Stepper Motor Controllers.
The ARM Processor: Processor architecture and memory organization, Data operations, Flow of control,

Pipelining in ARM, Timing of execution, FIR filter implementation using ARM.

Programming Embedded Systems: Design patterns for embedded systems, Data flow graphs, Control/ Data flow graphs, Assembly and Linking, Basic Compilation techniques, Analysis and optimization of execution time.

Real-Time Operating Systems (RTOS): Real-time Kernels, Types of real-time operating systems, Real-time scheduling, RTOS issues, Implementing real-time operating system.

Embedded System Specification: UML as design tool, UML notation, Requirement analysis and Use case modelling, Static modelling, Object and Class structuring, Dynamic modelling.

Design Case Studies: i) Data Compressor, ii) Alarm Clock, iii) Software Modem, iv) Elevator Controller, v) Digital Camera

Text Books:

1.	Computers as Components: Principles of Embedded Computing Design	W. Wolf	Morgan Kaufmann Publishers
2.	Embedded System Design: A Unified Hardware /Software Introduction	F. Vahid and T. Givargis	John Wiley & Sons
3.	Embedded Systems: A Contemporary Design Tool	Peckol, K. James	John Wiley & Sons

L T P C

EC 1429 ANALOG AND DIGITAL FILTER DESIGN (Elective-I) 3-0-0-6

Pre-requisite- Signal & System, DSP, Analog Electronics.

Introduction, Time and Frequency response Poles and Zeros, Analog Low Pass, High pass, Band Pass and Band Stop Filter Design, Selecting Components for Filters, Filters for Phase locked Loop (PLL), Integrated Circuit Filter Design, Introduction to Digital filters, Digital FIR Filter Design, Digital IIR Filter Design, Noise Analysis in Filter.

Text/Reference books:

1.	Analog Filter Design	Van Valkenberg	Oxford University Press
2.	Design of Analog Filters	Roll Schaumann	Oxford University Press
3.	Analog & Digital Filters Design and Realization	H Y F Lam	PHI
4.	Digital Filter Design	Antonou	TMH

L T P C

EC 1431 ARCHITECTURES OF DIGITAL SIGNAL PROCESSORS 3-0-0-6

(Elective II)

Pre-requisite-DSP, Microprocessor.

Introduction: Computational characteristics of DSP algorithms and applications; Techniques for enhancing computational throughput: Harvard architecture, parallelism, pipelining, dedicated multiplier, split ALU and barrel shifter.

TMS320C67xx architecture: CPU data paths and control, general purpose register files, register file cross paths, memory load and store paths, data address paths, parallel operations, resource constraints; Assembly language: Programmers model, functional units, Fetch and execute packets, pipelining, linear and circular addressing, assembler directives, addressing modes, instructions.

Memory: Program memory, data memory, and memory configuration. External memory interface (EMIF), fixed point and floating point formats in contrast to TMS320C67xx.

Interrupts: Interrupt sources, interrupt control registers and interrupt acknowledgment; Peripherals: Timer, multi channel buffered serial port, DMA, general purpose IO; DSP Real Time system operating systems; Applications: a few case studies of application of DSPs in communication and multimedia.

Texts/References:

1.	Digital signal processing and applications with Tms320C6713 and TMS320C6416	Rulph Chassaing and Donald Reay	John Wiley & Sons
2.	Digital signal processing, Implementation using DSP Microprocessors with examples from TMS320C54xx	Avtar Singh and S.Srinivasan	Cengage Learning

3.	TMS320C64x Technical Overview, Texas Instruments, Dallas, TX, 2001.
4.	TMS320C6000 Peripherals Reference Guide, Texas Instruments, Dallas, TX, 2001.
5.	TMS320C6000 CPU and Instruction Set Reference Guide, Texas Instruments, Dallas, TX, 2000.
6.	IEEE Signal Processing Magazine: Oct 88, Jan 89, July 97, Jan 98, March 98 and March 2000.

L T P C

EC 1432 **ADVANCED VLSI DESIGN (Elective II)** **3-0-0-6**

Pre-requisite- VLSI Design.

Implementation strategies for Digital ICs: Custom, semi-custom, structured array design approaches, custom circuit design, cell based system design methodology – standard cell, compiled cell, macro-cell, mega-cell, intellectual property, array based implementation – pre-diffused array, pre-wired array.
Interconnect: Capacitive, resistive and inductive parasitic, advanced interconnect techniques – reduced swing circuits, current mode transmission techniques, Network-on-Chip.
Timing Issues: Timing Classification of digital circuits, synchronous design, self timed circuit design, synchronizers and arbiters, clock synthesis and synchronization.
Design Verification: Data paths in digital processor architectures, multiplier, shifter, other arithmetic operators, power and speed trade-offs in data path structures.
Memory and array structures: Memory core, memory peripheral structures, power dissipation in memories, case study-PLA, SRAM etc.
Validation and test of manufactured circuits: Design for testability- Ad Hoc testing, scan based test, boundary scan test, built-in-self test (BIST), test pattern generation- fault models, automatic test pattern generation, fault simulation.

Text/Reference books:

1.	Digital Integrated Circuits- A Design Perspective	J.M. Rabaey, A. Chandrakasan and B. Nikolic	PHI
2.	CMOS VLSI Design: A Circuits and Systems Perspective	N. Weste and D. Harris	Pearson

L T P C

EC 1433 **ADVANCED OPTICAL COMMUNICATION (Elective II)** **3-0-0-6**

Pre-requisite- Opto Electronics & Networks

Optical fibers: Review of fundamentals, full EM analysis of cylindrical optical fibers, study of PMD, profile dispersion, dispersion flattened and dispersion compensated fibers.
Component: WDM, DWDM, optical passive components and their design. Study of optical couplers, isolators, Circulators, filters, polarizers. Optical fiber measurements and testing, link certification, introduction to time domain reflectometer techniques.
Networking: Optical networking and design issues, FDDI, fiber in local loop, subscriber loop, fiber optic LAN, SDH & SONET, networking topologies and access control protocols.
Sources and Detectors: Advanced optical sources & detectors. Optical amplifiers, their reliability issues, new materials and process technologies for optical device fabrication. Optical integrated circuits, hybrid & monolithic systems, optical inter-connects, material and processing for OEIC.
Measurement: Optical sensors intrinsic & extrinsic, principles of pressure, temperature, displacement and velocity measurements.

Text Books:

1.	Fiber optics communication	G.P Agrawal	John Wiley
2.	Optical Fiber Communication	John M. Senior	Pearson Education
3.	Optical Fiber Communication	Gerd Keiser	Mc Graw Hill

Reference Books:

1.	Fiber-Optic Systems for Telecommunications	R. L. Freeman	John Wiley & Sons, Inc.
2.	Coding for Optical Channels	I. B. Djordjevic, W. Ryan, B. Vasic	Springer

L T P C

EC-1434 ADVANCED TOPICS IN DIGITAL SIGNAL PROCESSING 3-0-0-6

(Elective II)

Pre-requisite- DSP

Multirate Signal Processing:

Fundamentals of Multirate Systems: Introduction, basic multirate operations, interconnection of building blocks, polyphase representation, multistage implementations, special filters and filter banks; Maximally Decimated Filter Banks:- Introduction, errors created in QMF bank, alias free QMF system, power symmetric QMF banks, M-channel filter banks, polyphase representation, perfect reconstruction systems; Paraunitary Perfect Reconstruction (PR).

Filter Banks: Introduction, lossless transfer matrices, filter bank properties induced by para-unitariness, two channel FIR paraunitary QMF banks, two channel paraunitary QMF lattice, M-channel FIR paraunitary filter banks; Linear Phase Perfect Reconstruction QMF Banks:- Introduction, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice; Cosine modulated Filter Banks: Introduction, pseudo QMF bank, design of pseudo QMF bank, efficient polyphase structures, cosine modulated perfect reconstruction systems. Applications of Multirate Signal Processing: Analysis of audio, speech, image and video signals.

Time-Frequency Signal Analysis and Processing:

Time-Frequency Concepts: Time-domain representation, frequency domain representation, joint time-frequency representation, desirable characteristics of a time-frequency distribution (TFD), analytic signals, Hilbert transform, duration, bandwidth, bandwidth duration product, uncertainty principle, instantaneous frequency, time delay.

Time-Frequency Distributions: Wigner distribution, wigner-ville distribution, time-varying power spectral density, short-term Fourier transform, spectrogram, Gabor transform, instantaneous power spectra, energy density, quadratic TFDs, relationship between TFDs; Applications of Time-Frequency Analysis:- analysis of non-stationary signals like speech, audio, image and video signals.

Texts/References Books:

1.	Multirate Systems and Filter Banks	P. P. Vaidyanathan	Pearson-Education
2.	Time-Frequency Signal Analysis and Processing: A Comprehensive Reference	B. Boashash	Elsevier, UK
3.	Time-Frequency Analysis	L. Cohen	Prentice Hall
4.	Audio Signal Processing & Coding	A. Spanias, T. Painter & V. Atti	Wiley-Interscience, NJ, USA

L T P C

EC 1435 ANTENNA & WAVE PROPAGATION (Elective II) 3-0-0-6

Pre-requisite- Electromagnetics and Microwave Engineering

Radiation Mechanism and Basic Antenna Concept: Physical concept of radiations, Retarded potentials, Radiation from a short current element, Radiation from small current loop, Radiation from arbitrary current distribution, Concept of antenna impedance; Antenna Parameters- radiation pattern, radiation resistance, gain, directivity, beam width, band width, effective aperture, polarization, reciprocity etc.

Antenna Terminology: Introduction, Networks Theorems- Superposition Theorem, Thevenin's Theorem, Maximum Power Transfer Theorem, Compensation Theorem, Reciprocity Theorem and proof, Application of Network Theorems to Antennas- Equality of Directional Patterns, Equivalence of Transmitting and Receiving Antenna Impedances, Equality of Effective Lengths.

Antenna Arrays: Introduction, Various forms of arrays, Arrays of two point sources, Non isotropic but similar point sources, Pattern Multiplication, Generalized expression of principle of pattern Multiplication, Radiation pattern characteristics, Binomial Arrays, Electronic Phased Arrays, Effect of earth on Vertical patterns and Radiation resistance, Methods of excitation of antennas, Impedance matching techniques.

HF, VHF, and UHF Antennas: Introduction, Isotropic Radiators, Directional Antennas, Omni-directional antennas, Resonant antennas, Non resonant antennas, LF antennas, Antennas for HF, VHF, UHF; linear wire antennas,

Dipole arrays, Folded dipole antennas, V-antennas, Inverted V antennas, Rhombic antennas, Yagi-Uda antenna, Log-periodic antenna, Helical antenna, Loop antenna.

Microwave Antennas: Introduction, Rod reflector, Plane reflector, Corner reflector, parabolic reflector, Types of Parabolic reflectors- Cut paraboloid, Parabolic cylinder, Offset paraboloid, Torus antenna; Feed systems for parabolic Reflectors, Shaped beam antennas, Horn antenna, Corrugated Horn, Slot antenna, Babinet's principle, The Method of Moment(MOM), lens antenna, Microstrip or patch antenna.

Wave Propagation: Ground wave, Space wave & Sky wave propagation, Structure of Ionosphere & Ionospheric propagation, Effect of earth magnetic field, Faraday Rotation, line of Sight (LOS) propagation, Tropospheric & Scatter propagation, Duct propagation, Multipath Fading, Ray bending and other propagation phenomenon, indoor propagation, Critical frequency, Virtual height, MUF, Skip distance, Optimum Working Frequency, Wave angle fading, Selective fading.

Texts/Reference Books:

1.	Antenna Theory	Balanis	Wiley India Pvt Ltd
2.	Antennas	Kraus & Marhepka	TMH
3.	Antenna & Radio Wave Propagation	Collin	Mcgraw-hill Education (ise Editions)
4.	Propagation of Radio Waves	M.Drhekhanor	
5.	Antenna & Wave propagation	R.L.Yadava	Ashirwad Publications
6.	Antenna and Wave Propagation	K.D.Prasad, Deepak Handa	Satya Prakashan

L T P C

EC 1436 DETECTION AND ESTIMATION THEORY (Elective II) 3-0-0-6

Pre-requisite- Probability & Random Process, Digital Communication.

Detection theory, hypothesis testing, Bayes, minimax, and Neyman-Pearson criteria, signaling in additive Gaussian noise, receiver operating characteristic, M-ary hypothesis testing, MAP and ML decision rules. Estimation of random parameters, MMS and MAP estimates. Estimation of nonrandom parameters, Cramer-Rao inequality, consistent estimate, Bounds on estimation errors, composite hypotheses, Elements of sequential and non-parametric detection, Wiener-Hopf and Kalman filtering.

Reference/Text Books:

1.	An Introduction to Signal Detection and Estimation	H Vincent Poor	Springer
2.	Detection, Estimation and Modulation Theory, Vol-I	Harry L Van Trees	John Wiley & Sons

EC 1437 SMART ANTENNAS FOR WIRELESS COMMUNICATION(Elective II) L T P C

Pre-requisite- Principles of Communication Engineering, Digital Communication, Electromagnetic field theory and wave propagation **3-0-0- 6**

*Introduction:*Antenna gain, Phased array antenna, power pattern, beam steering, degree of freedom, optimal antenna, adaptive antennas, smart antenna - key benefits of smart antenna technology, wide band smart antennas, Digital radio receiver techniques and software radio for smart antennas.

Narrow Band Processing: Signal model conventional beamformer, null steering beamformer, optimal beamformer, Optimization using reference signal, beam space processing.

Adaptive Processing: Sample matrix inversion algorithm, unconstrained LMS algorithm, normalized LMS algorithm, Constrained LMS algorithm, Perturbation algorithms, Neural network approach, Adaptive beam space processing, Implementation issues.

Broadband Processing: Tapped delay line structure, Partitioned realization, Derivative constrained processor, Digital beam forming, Broad band processing using DFT method.

Direction Of Arrival Estimation Methods: Spectral estimation methods, linear prediction method, Maximum entropy method, Maximum likelihood method, Eigen structure methods, Music algorithm – root music and cyclic music algorithm, the ESPRIT algorithm.

Diversity Combining: Spatial diversity selection combiner, switched diversity combiner, equal gain combiner, maximum ratio combiner, optical combiner.

Text/Reference books:

1.	Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA Applications	Joseph C Liberti.Jr and Theodore S Rappaport	Prentice Hall
2.	Smart Antennas	Lal Chand Godara	CRC press
3.	Antennas	Balanis	John Wiley and Sons

EC 1438 **RECONFIGURABLE COMPUTING AND RECONFIGURABLE HARDWARES (Elective II)** **L T P C 3-0-0-6**

Pre-requisite-Digital, VLSI, Communication, Computer Organisation & Architecture

Introduction, Field Programmable Gate Arrays, FPGA Placement, FPGA Routing, Contrasting Processors: Fixed and Reconfigurable, Coarse-grained Reconfigurable Devices, Reconfigurable Systems.
Multi-FPGA Partitioning, Logic Emulation, Power Reduction Techniques for FPGAs, High-Level Compilation, Reconfigurable Coprocessors, Reconfigurable Memory Security, Network Virtualization, GPGPU on FPGA.
Few applications may be discussed e.g.
Reconfigurable Weather Radar Data Processing, Dynamically Reconfigurable Adaptive Viterbi Decoder, High Speed Data Acquisition System for Space Applications

Text/Reference books:

1.	Reconfigurable Computing	Scott Hauck and Andre DeHon, Morgan Kaufmann	Elsevier India Pvt. Ltd.-New Delhi
2.	FPGA Prototyping by Verilog Examples: Xilinx Spartan-3 Version	Pong P. Chu	Wiley-Interscience
3.	Rapid Prototyping of Digital Systems	ISBN-10: 0792374398 James O. Hamblen, Tyson S. Hall, Michael D. Furman	Springer
4.	The Design Warrior's Guide to FPGAs: Devices, Tools and Flows	ISBN-10: 0750676043 Clive Max Maxfield	Reed Elsevier India
5.	Advanced FPGA Design: Architecture, Implementation, and Optimization.	ISBN-10: 0470054379 Steve Kilts	IEEE Computer Society Press

L T P C

EC 1439 **OPTIMAL & ADAPTIVE CONTROL SYSTEM (Elective II)** **3-0-0-6**

Pre-requisite- Control System

Introduction to control systems: Introduction to control systems, properties of signals and systems. Convolution integral, Ordinary differential equation, Transfer function, Pole zero concepts, effect of pole location on performance specification.
State Space analysis: State equations for dynamic systems, State equations using phase, physical and canonical variables, realization of transfer matrices, Solution of state equation, concepts of controllability, observability, Controllability and Observability tests.
Discrete time control systems: Sampling theorem, Sampled-data systems, the sample and hold element, pulse transfer function, The Ztransform, stability analysis.
Stability: Liapunov's method, generation of Liapunov's function, Popov's criteria, design of state observers and controllers, model reference.
Parameter estimation methods, minimizing predication errors, linear regressions & Least square method, Recursive algorithms, closed loop identification.
Adoptive control: Close loop & open loop adoptive control, Self – tuning controller, Auto tuning for PID controller: Relay feedback, pattern recognition, Correlation techniques.
Optimal Control: Introduction , formation of optimal control problems, calculus of variation, minimization of functions, constrained optimization, dynamic programming, performance index , optimality principles, Hamilton – Jacobian equation, linear quadratic problem, Ricatti II equation and its solution, solution of two point boundary value problem.

Text Books:

1.	Modern Control Engineering	K. Ogata	Prentice Hall of India
2.	Modern Control System	M. Gopal	Wiley Eastern
3.	Adaptive Control, Second Edition	K. Astrom	Pearson Education Asia Pte Ltd

Reference Books:

1.	Optimal Control System: Linear Quadratic Methods	B.D.O. Anderson and IB. Moore	Prentice Hall International
2.	Control System of Variable Structure	U. Itkis	John Wiley and Sons
3.	Linear Optimal Control System	H. Kwakemaok and R. Sivan	Wiley Interscience

EC 1471 **NEURAL NETWORKS AND FUZZY LOGIC** **L T P C**

(Open Elective I) **3-0-0-6**

Pre-requisite- None

Introduction: A New Breed of Processor: The Brain, The Engineering of the Brain, A world of Fuzzy Thinking, Crisp versus Fuzzy Logics, Fuzzy and Neural Networks, Where Are Fuzzy Neural Networks Headings, Objectives.

Biological Neural Networks: The Axon: A Transmission Line, The Synapse, The Synapse, Biocomputer, Types of Synapses, The Developing Neuron: Forming Networks, Neuronal Specialization, The Cell's Biological Memory, Weighting Factor, Factors Affecting Potassium ion Flow, Firing in a Nutshell, Neuronal, Diversity, Specifications of the Brain, The Eye's Neural Network, Retina Structure, Rods and Cones, From photons to Electrons, A Photochemical Chain Reaction Organization and Communication of the Retina Neural Network, Image Processing in the Retina, Visual Pathways.

Artificial Neural Networks Concepts: Neural Attributes, Artificial Neural Networks, Same Mathematics Again, Modeling, Basic Model of a Neuron, Learning in Artificial Neural Networks, Supervised Learning, Unsupervised Learning, Reinforced Learning, Competitive Learning, The Delta Rule, Gradient Descend Rule, Hebbian Learning Characteristics of ANNs, Important ANN Parameters, Artificial Neural Network Topologies, Modeling ANNs, ANN Learning and Program, Learning Algorithms, Discrimination Ability, Linearly Separable ANNs, Multilinear ANNs, Nonlinear Separable ANNs, ANN Adaptability, The Stability-Plasticity Dilemma.

Neural Network Paradigms: Mc Culloch- Perception, The Perception, ADALINE and MADALINE Models, Winner- Takes- All Learning Algorithm, Back – Propagation Learning Algorithm, Learning with the Back-Propagation Algorithm, Mathematical Analysis, Application, Criticism, Cerebellum Model Articulation Controller (CMAC), Adaptive Resonance theory (ART) Paradigm, The ART Algorithm, Hopfield Model, Mathematical Analysis, The Hopfield Learning Algorithm Discrete-Time Hopfield Net, Competitive Learning Model, Memory Type Paradigms, Random Access Memory (RAM), Content Addressable Memory (CAM), Bidirectional Associative Memory (BAM), Content Addressable Memory (TAM), Linear Associative Memory (LAM), Real –Time Models, Linear Vector Quantization (LVQ), self- Organizing Map (SOM), Probabilistic Neural Network (PNN), Radial Basis Function (RBF); Time-Deal Neural Net (TDNN), Cognitron and Neocognitron Models, Simulated Annealing, Boltzmann Machine, Other Paradigms, Restricted Coulomb energy (RCE), Culbertson's Model, Encephalon Project, Cellular Neural Networks, Logicon Projection Networks (LPN), Probabilistic RAM (Pram-256), Neural Acceleration Chip (NAC).

Fuzzy Logic: Propositional Logic, The Membership Function, Fuzzy Logic, Fuzzy Rule Generation, Defuzzification of Fuzzy Logic, Time – Dependent Fuzzy Logic, Crisp Logics, Fuzzy Logics, Temporial Fuzzy Logic (TFL), Time – Invariant Membership Function, Time –Variant Membership Function, Intervals, Semi large Intervals, Interval Operators, Temporial Fuzzy Logic Syntax, Applying Temporial Fuzzy, Operators, Deffuzzification of temporal Fuzzy Logic Example, Applicability of TFL IN Communications Systems, Temporal Fuzzification, Rules and Temporal Defuzzification.

Fuzzy Neural Networks: Fuzzy Artificial Neural Network (FANN), Neural – Fuzzy Control, Traditional Control, Neural Control, Fuzzy control, Fuzzy- Neural Control.

Text/Reference books:

1.	An Inroduction to Fuzzy Control	D. Driankov, H. Hans, R. Michael	Springer-Verlag
2.	Neural Computing - An Introduction	R. Beale, T. Jackson	Adam Hilger
3.	Neural Networks and Fuzzy Systems - A Dynamical	B. Kosko	PHI

	System Approach to Machine Intelligence		
4.	Neural Network	Simon Hykins	PHI
5.	Neural Network	B. Yegnarayana	PHI

EC 1472 **PROCESS CONTROL AND INSRUMENTATION** **L T P C**

(Open Elective I)

Pre-requisite- Analog Electronic Circuits, Pulse and Digital Electronic Circuits, Measurement and Instrumentation **3-0-0-6**

Process Modeling-Introduction to Process control and process instrumentation - Hierarchies in process control systems - Theoretical models - Transfer function - State space models - Time series models - Development of empirical models from process data -Chemical reactor modeling .

Introduction to Nonlinear process control-Model Reference Nonlinear Controller (MRNC)-MRNC incorporating integral and derivative actions- MRNC for systems with relative order two or higher, Series cascade control of nonlinear systems, parallel cascade control of nonlinear systems, Control of nonlinear , non-minimum phase systems with inputmultiplicities. Parallel cascade control of non-minimum phase systems with inputmultiplicities- control of nonlinear systems with significant actuator dynamics, Control ofnonlinear systems with actuator delay, nonlinear control of multi variable systems with inputor output constraints, problems.

Introduction to controller characteristics-process characteristics, process equation, process load,process lag, self-regulation, control system parameters, error, variable range, controlparameter range, control lag, dead time, cycling, controller modes, discontinuous controller modes, two-position modes, multi-position mode, floating control mode, continuous
controller modes, composite controller modes.

Advanced process control-Multi-loop and multivariable control – Process Interactions - Singular value analysis-Tuning of multi loop PID control systems-Decoupling control.

Text/Reference books:

1.	Nonlinear Process Control	Chidambaram M	New Age International (P) limited publishersNew Delhi
2.	Instrumentation Technology	Johnson D Curtis	Prentice Hall India
3.	Measurement system Application and Design	Ernest O. Doebelin	McGraw Hill International Editions
4.	Process Dynamics and Control	Seborg, D.E., T.F. Edgar, and D.A. Mellichamp	John Wiley
5.	Process Control	K. Krishnaswamy	New Age International

EC 1473 **MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)** **L T P C**

(Open Elective I) **3-0-0-6**

Pre-requisite- Physics of Semiconductor & Devices, Basic Electrical.

Introduction: What is MEMS? Unique Characteristics of MEMS and Typical Application Areas of MEMS.

Review of Basic IC fabrication: Deposition, lithography, oxidation, etching, Plasma etching, Sputtering, RIE, 1, 2 and 3 mask level processes, wet etching (anisotropic and isotropic), crystal directions in Si, Bulk micro-machining, wafer bonding, SOI, Bulk/Surface micro-machining.

Introduction to MEMS devices: Stress, strain, introduction to beam theory, Resonance (transfer function) and Q factor.

Electromechanical Transducers: Introduction to electrostatic actuators/motors, capacitive sensors (Pressure, Acceleration, etc.), Electrostatic Actuators (Micromirrors, Resonators, etc.)

Piezoresistive Transducers: Piezoresistance, pressure Sensors and Strain Gauge.

Electrothermal MEMS: Flow Sensors, Gas Detectors, Uncooled Infrared Sensors, Bimorph Actuators, Bent-Beam Actuators.

Overview of CMOS and MEMS in CMOS.

Overview of BioMEMS, RF MEMS and Microfluidics.

Text/Reference books:

1.	Foundations of MEMS	Chang Liu	Pearson Education
2.	Microsystem Design	S. D. Senturia	Springer

L T P C

EC 1411 **ELECTRONICS LABORATORY VIII (ADVANCED COMMUNICATION ENGG.)** **0-0-2-2**

Pre-requisite- Advanced Communication Theory

(Students are required to complete minimum 10 experiments, taking at least 3 from each group)

A. Optical Communication System:

1. Measurement of numerical aperture of an optical fiber.
2. Measurement of propagation loss, bending loss and connector loss in an optical fiber
3. Studies of LASER characteristics
4. Measurement of wavelength of an optical fiber source.
5. Setting up a fiber optic analog link, study of PAM.
6. Studies of Frequency Division Multiplexing and De multiplexing.
7. Setting up a fiber optic data link and study of TDM.
8. Setting up a PC to PC communication link using optical fiber.

B. Wireless communication System (Experiments are to be performed in simulated Platform or in experimental models):

1. Studies on cellular mobile communication system :–

i) To study specifications of a Cellular Phone, working principle, input/output signals of different sections, ringer section, dialer section, speech amplifier section, transmitter section, receiver section, details of SIM card,

ii) To understand and perform operational procedure, demonstrate different types of faults.

2. Studies on GSM:–

i) To study GSM theory and understanding of GSM technology, its network

ii) To study different parts like antenna, RF module, connectors, measurement of various signals like SIM reset, SIM clock, SIM data.

3. Study on Satellite Communication System:–

i) To set up active and passive satellite Communication link,

ii) To set up an FM / FDM satellite link,

iii) To measure the path loss and propagation delay in a satellite link,

iv) To communicate voice signal through satellite link, use different combinations of uplink and downlink frequencies to check the communication link,

v) To transmit and receive various waveforms from a function generator through a satellite link.

4. Study on Blue Tooth System:–

i) To understand concept of Blue tooth technology,

ii) To study RF module, RS-232C serial communication, Blue tooth protocol, different types of Blue tooth network.

5. Study on wireless LAN.

C. Microwave & Antenna System:

1. Radiation Pattern (E-Plane, H-Plane, 3-dB Beam-width, No. of Side-Lobes, FNBW; Polar & Rectangular Plots of patterns) of aperture antennas e.g., Horn antennas, Open-ended Waveguides, Parabolic Reflectors.
2. Gain, Directivity and Beamwidth of a three-element Yagi-Uda antenna.
3. VSWR and Reflection coefficient of a coaxial line for various load condition using frequency domain Technique.
4. Study of Spectrum Analyzer.
5. Determine the frequency and guided wavelength in a rectangular waveguide for TE10 mode.
6. Study the V-I characteristic of Gunn diode.
7. Measure the impedance of a capacitive window by using shift in minima technique.

EC 1403 **ADVANCED COMMUNICATION ENGINEERING** **L T P C**
3-0-0-6

Pre-requisite- Analog & Digital Communication

Semester-8

Review of Digital Modulation Techniques: Review of digital modulation schemes and comparing in terms of BW, SNR, BER, bit/words rates in context to wireless Communication.
Receiver Design: Receivers in additive white Gaussian noise channels, CPM, MSK, CPFSK; Intersymbol interference; Adaptive receivers and channel equalization.
Carrier Synchronization: MMSE, ZFE, FSE; Carrier and clock synchronisation; Effects of phase and timing jitter.
Channel Coding Scheme: Block codes, Convolutional codes and their performance evaluation; Coded modulation schemes: TCM; Turbocodes.
Channel Modeling Techniques: Digital transmission over fading channels.

Texts/ References books:

1.	Principles of Digital Transmission with Wireless Applications	S Benedetto and E Biglieri	Kluwer Academic
2.	Principles of Digital Communication	R G Gallager	Cambridge University Press
3.	Digital Communications	J G Proakis	McGraw Hill
4.	Fundamentals of Digital Communication	U Madhow	Cambridge University Press

EC 1441 **VLSI-DSP BASED DESIGN (Elective III)** **L T P C**
3-0-0-6

Pre-requisite- VLSI, DSP.

IC basics - power, delay, throughput, bandwidth, non-linearity.
Algorithm transforms, retiming, pipelining, parallel processing, unfolding, folding and dynamic algorithm transforms (DAT).
Signal processing kernels for communications, analog filters, digital filters, adaptive filters, finite-precision filters.
Detection kernels and architectures for communications, symbol-by- symbol (SBS) detectors (with and without ISI), sequence detectors.
Source compression, lossless (Huffman, arithmetic coding), lossy (quantization, DCT, DPCM, ADPCM, Motion estimation.
Single-carrier Systems and Architectures, constellations, waveform shaping, Nyquist signaling, partial-response signaling, equalization.
Multi-carrier (DMT and OFDM) Systems and Architectures. Architectures for multi-input, multi-output (MIMO) receivers.
Introduction to ECC, finite-field arithmetic, architectures for algebraic codes (Reed-Solomon, BCH). Convolutional codes, Viterbi algorithm and architecture, soft-output Viterbi architecture (SOVA), and the MAP architecture, Turbo and LDPC decoder architectures

Text/Reference books:

1.	VLSI for Wireless Communication	B. Leung,	Springer/Dorling Kinderslay/Pearson
2.	RF Microelectronics	B. Razavi,	Dorling Kinderslay/Pearson
3.	CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters	R. J. Plassche	Springer/BSP Books
4.	Digital Compensation for Analog Front-Ends: A New Approach to Wireless Transceiver Design	F. Horlin and A. Bourdoux	John Wiley & Sons
5.	VLSI Digital Signal Processing Systems, Design and Implementation	K. K. Parhi	Wiley India Pvt Ltd
6.	Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing	J.E. Franca and Y. Tsividis	Prentice Hall- Gale
7.	Digital Signal Processing – A Practical Approach	E. C. Ifeachor and B. W. Jervis	Dorling
8.	Digital Communications	B. Sklar	Prentice Hall
9.	Synthesis and Optimization of Digital Circuits	Micheli Giovanni De	Tata Mcgraw Hill

EC 1442 **ANALOG IC DESIGN (Elective III)** **L T P C**
3-0-0-6

Pre-requisite- Analog Electronics, VLSI.

Differential amplifiers: Single ended and Differential operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS loads.
Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors.
Operational Amplifiers: General Considerations, One- Stage Op-Amp, Two- stage Op-Amp, gain Boosting, Common Mode feedback, Input Range limitations, Slew Rate, Power Supply Rejection Ratio, Noise in Op-Amp.
Noise: Statistical characteristics of Noise, Types of noise, Representation of Noise in Circuits, Noise in Single Stage Amplifiers, Noise in Differential Pairs, Noise BW.
Stability and Frequency Compensation: General considerations, Multipole Systems, Phase Margin and Gain Margin, Frequency Compensation : Compensation of Two Stage Op-Amp, Other Compensation Techniques.
Wave generators and wave shaping: Sinusoidal oscillator, Phase shift oscillator, Wein bridge oscillator, Square wave and triangular wave generator, Voltage time base generator, step generator, Modulation of square wave.
Filters: Active RC filters, Butterworth & Chebyshev filter function, switched capacitor filter.

Text/Reference books:

1.	Design of Analog CMOS Integrated Circuits	Behzad Razavi	TMH
2.	Analysis & Design of Analog Integrated Circuits	Gray, Hurst, Lews, and Meyer	Wiley India Pvt Ltd
3.	CMOS Analog Circuit Design	Allen and Holberg	Oxford University Press
4.	Analog IC Design	John & Martin	Wiley

EC 1443 **ADAPTIVE SIGNAL PROCESSING (Elective III)** **L T P C**
3-0-0-6

Pre-requisite- DSP, Adaptive Control Theory.

Introduction to Adaptive Filters: Adaptive filter structures, issues and examples, Applications of adaptive filters: Channel equalization, active noise control, Echo cancellation and beamforming.
Discrete time stochastic processes: Re-visiting probability and random variables, Discrete time random processes, Power spectral density – properties, Autocorrelation and covariance structures of discrete time random processes, Eigen-analysis of autocorrelation matrices.
Wiener filter, search methods and the LMS algorithm: Wiener FIR filter (real case), Steepest descent search and the LMS algorithm, Extension of optimal filtering to complex valued input, The Complex LMS algorithm.
Convergence and Stability Analyses: Convergence analysis of the LMS algorithm, Learning curve and mean square error behavior, Weight error correlation matrix, Dynamics of the steady state mean square error, Misadjustment and stability of excess mean square error.
Variants of the LMS Algorithm: The sign-LMS and the normalized LMS algorithm, Block LMS, Review of circular convolution, Overlap and save method, circular correlation, FFT based implementation of the block LMS Algorithm.
Vector space framework for optimal filtering: Axioms of a vector space, examples, subspace, Linear independence, basis, dimension, direct sum **o**f subspaces, Linear transformation, examples, Range space and null space, rank and nullity of a linear operator, Inner product space, orthogonality, Gram-Schmidt orthogonalization, Orthogonal projection, orthogonal decomposition of subspaces, Vector space of random variables, optimal filtering.
The lattice filter and estimator: Forward and backward linear prediction, signal subspace decomposition using forward and backward predictions, Order updating the prediction errors and prediction error variances, basic lattice section, Reflection coefficients, properties, updating predictor coefficients, Lattice filter as a joint process estimator, AR modeling and lattice filters, Gradient adaptive lattice.
RLS lattice filter: Least square (LS) estimation, pseudo-inverse of a data matrix, optimality of LS estimation, Vector space framework for LS estimation, Time and order updating of an orthogonal projection operator, Order updating prediction errors and prediction error power, Time updating PARCOR coefficients.

Text Books/ References:

1.	Adaptive Filter Theory	S. Haykin	Prentice Hall, Englewood Cliffs, NJ
2.	Adaptive Filters – Theory and Applications	B. Farhang-Boroujeny	John Wiley and Sons
3.	Fundamentals of Adaptive Filtering	Ali H. Sayed	John Wiley
4.	Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing	D. Manolakis, V. Ingle and S. Kogan	McGraw Hill
5.	Adaptive Signal Processing	B. Widrow and S. Stearns	Prentice-Hall

EC 1444 **MOBILE AND CELLULAR COMMUNICATION (Elective III)** **L T P C 3-0-0-6**

Pre-requisite- Communication (Digital)

Introduction to Wireless/Cellular communication: Representation of a mobile radio signal; propagation path loss and fading: causes, types of fading and classification of channels; prediction of propagation loss, Mobile radio transmitters, receivers and link designing, prediction over flat terrain, point to-point prediction, microcell prediction model.
Fundamentals of Cellular Design/Architecture: Hexagonal cell design and its SNR calculation, splitting and sectoring cells, microcell systems: conventional cellular system, microcell system design, capacity analysis traffic analysis in terms of erlang.
Small Scale and Large Scale Fading: Multipath and fading channels measurements, calculation of fades: amplitude fades, random PM and random FM, selective fading, diversity schemes, Combining techniques, bit-error-rate and word-error-rate; mobile radio interference: co-channel and adjacent-channel interference, intermodulation, inter symbol and simulcast interference.
Outdoor/Indoor Propagation Model: Outdoor and indoor channel models Okumara and Hata models etc.
Introduction to GSM: GSM models and its frequency plane, over view of modulation schemes suitable for cellular communications. Spectral efficiency.
Mobile Antenna: Introduction and Fundamentals: Antenna configurations, noise, power and field strength; design parameters at mobile unit: directional antennas and diversity schemes: frequency dependency; noise; antenna connections.

. **Texts/References Books:**

1.	Mobile Communications Design Fundamentals	W. C. Y. Lee	Wiley
2.	Wireless Communications	T. S. Rappaport	Prentice-Hall
3.	Principles of Mobile Communications	G. H. Stuber	Kluwer
4.	Mobile Radio Communications	R. Steele and L. Manzo	John Wiley
5.	Mobile Data Communication Systems	P. Wong and D. Britland	Artech House
6.	Mobile Cellular Telecommunications	W. C. Y. Lee	McGraw Hill

EC 1445 **DATA MINING (Elective III)** **L T P C 3-0-0-6**

Pre-requisite- None

Introduction: Data warehousing – definitions and characteristics, Multi-dimensional data model, Warehouse schema.
Data Marts: Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart.
Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi dimensional view, snowflake schema; OLAP tools.
Developing a Data Warehousing: Building of a Data Warehousing, Architectural strategies & organizational

issues, design considerations, data content, distribution of data, Tools for Data Warehousing.
Data Mining: Definitions; KDD (Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, DataMining Techniques; Issues and challenges; Applications of Data Warehousing & Data mining in Government.
Association Rules: A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; generalized association rule.
Clustering Techniques: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; Categorical clustering, STIRR, ROCK, CACTUS.
Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.
Web Mining: Web content Mining, Web structure Mining, Web usage Mining, Text Mining.
Temporal and Spatial Data Mining: Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.

Texts/References Books:

1.	Data Mining	Han & Kamber, Morgan Kaufman	Elsevier
2.	Data Warehousing –Concepts, Techniques, products, application	Prabhu	PHI
3.	Data Mining Techniques	A. K. Pujari	Universities Press
4.	Data Warehousing, Data Mining and OLAP	Alex Berson and Stephen J Smith	TMH
5.	Data Warehousing in the real world	Anahory	Pearson Education
6.	Data Mining Introductory & Advanced Topic	Dunham	Pearson Education

EC 1446 **TELEMETRY (Elective III)** **L T P C**
3-0-0-6

Pre-requisite- Communication, Signal & System, Measurement & Instrumentation, Opto Electronics.

Introduction to Telemetry Principles: Classification, Non electrical telemetry systems, Voltage and current Telemetry systems, Frequency Telemetering. Introductory idea about Signal and systems and Transmission basics, Symbols and Codes, brief idea about: FDM & TDM systems, transmitters & receivers, transmission lines, Antennas, Wave propagation and filters.
Modem: Modems, quadrature amplitude modulation, modem protocols.
Basic satellite Telemetry: TT and C services, digital Transmission System in Satellite Telemetry, TDM, Satellite telemetry & communications, MAT techniques.
Fiber Optical Telemetry: Optical fiber cable, Dispersion, Losses, Sources and Detectors, Transmitters and Receiver circuits, wave length division multiplexing.
Related Topics: Remote control, Networking, Internet based Telemaking, Wireless LANs, Introduction to multimedia.

Texts/References Books:

1.	Telemetry System	L.E.Foster	J. Wiley
2.	Digital Instrumentation	A.J.Bouaens	Mcgraw-Hill
3.	Hand book of Telemetry Remote Control	E.L. Geruenbeng	McGraw-Hill
4.	Telemetry Principles	D.Patranabis	TMH

EC 1447 **CAD FOR VLSI (Elective III)** **L T P C**
3-0-0-6

Pre-requisite- VLSI

Introduction: VLSI design flow, challenges.
Verilog/VHDL: Introduction and use in synthesis, modeling combinational and sequential logic, writing test benches.
Logic synthesis: Two-level and multilevel gate-level optimization tools, state assignment of finite state machines.
Basic concepts of high-level synthesis: Partitioning, scheduling, allocation and binding. Technology mapping. Testability issues: fault modeling and simulation, test generation, design for testability, built-in self-test. Testing SoC's. Basic concepts of verification. Physical design automation.
VLSI design styles: Full-custom, standard-cell, gate-array and FPGA.
Physical design automation algorithms: Floor-planning, placement, routing, compaction, design rule check, power and delay estimation, clock and power routing, etc. Special considerations for analog and mixed-signal designs.

Text/Reference Books:

1.	Synthesis and Optimization of Digital Circuits	Giovanni De Micheli	TMH
2.	Algorithms for VLSI Design Automation	S. H. Gerez	John Wiley & Sons
3.	High Level Synthesis: Introduction to Chip and System Design	D. D Gajski et al	Springer
4.	Algorithms for VLSI Physical Design Automation	N. A. Sherwani	Springer
5.	An Introduction to VLSI Physical Design	M. Sarrafzadeh and C.K. Wong	Mcgraw-Hill
6.	Logic Synthesis	S. Devadas, A. Ghosh, K. Keutzer	Mcgraw-Hill

EC 1451 **DIGITAL SPEECH PROCESSING (Elective IV)** **L T P C**
3-0-0-6

Pre-requisite-Digital Signal Processing

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production, Digital models for speech signals.
Time Domain Models For Speech Processing: Introduction, Window considerations, Short time energy and average magnitude Short time average zero crossing rate, Speech vs. silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.
Linear Predictive Coding (LPC): Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Pitch Detection and using LPC Parameters.
Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, Mel frequency cepstrum computation.
Speech Enhancement: Nature of interfering sounds, Speech enhancement techniques: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter.
Automatic Speech Recognition: Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System.
Hidden Markov Model for Speech Recognition: Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMs, Adapting to variability in speech (DTW), Language models.
Speaker Recognition: Issues in speaker recognition and speech synthesis of different speakers. Text to speech conversion, Calculating acoustic parameters, synthesized speech output performance and characteristics of text to speech, Voice processing hardware and software architectures.

Text Books:

1.	Digital processing of speech signals	L.R Rabiner and S.W. Schafer	Pearson Education, Delhi, India
2.	Speech Communications: Human & Machine	Douglas O'Shaughnessy	IEEE Press
3.	Fundamentals of Speech Recognition	L.R Rabinar and B.H. Juang and B. Yegnanarayana	Pearson Education
4.	Discrete time processing of speech signal	J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis	Wiley-IEEE Press, NY, USA

References:

1.	Discrete Time Speech Signal Processing: Principles and Practice	Thomas F. Quateri	Pearson Education
2.	Speech and Audio Signal Processing	Ben Gold and Nelson Morgan	Wiley
3.	Speech Recognition	Claudio Becchetti and Lucio Prina Ricotti	Wiley

EC 1452 **INDUSTRIAL INSTRUMENTATION (Elective IV)** **L T P C 3-0-0-6**

Pre-requisite-Measurement & Instrumentation, Microprocessor.

Instrument in Industry: A brief idea (block diagram) of the industrial application of instrument in some process industries like Food, pulp and paper and power plant Instrumentation.
Transducer: Active and passive transducer for measurement of displacement, force pressure etc. working principle of tachometer, Electromagnetic flow meter, magnetostrictive transducers, feedback accelerometer, fibre optic sensors, electro-optical sensor in process industries.
Analytical Industrial Instrumentation: Measurement of pressure, Measurement of flow, Measurement of temperature, measurement of liquid level, measurement of humidity, gas chromatography. Instrument for gas analysis, X-RAY methods, Nuclear magnetic resonance spectrometry, mass spectrometry.
Instrument for Display, Recording, Alarm: Display methods, recorders, Alarm communication, Data logging system.
Telemetry: Pneumatic means, Electrical means, Frequency telemeting, multiplexing, modulation, Briefing of a telemetry system in operation.
Microprocessor based Instruments: Stepper motor control, Microprocessor based data acquisition system, Supervisory control, direct digital control, Distributed control system.

Text/Reference Books:

1.	Industrial Instrumentation	Umesh Rathore	S. K. Kataria & Sons
2.	Principle of Industrial Instrumentation	D. Patranabis	TMH

EC 1453 **ADVANCED INSTRUMENTATION (Elective IV)** **L T P C 3-0-0-6**

Pre-requisite- Measurement & Instrumentation.

Transducer Fundamentals: Transducer terminology, principles, design and performance characteristics, criteria for transducer selection, smart sensor, Resistive transducer; Inductive transducers; capacitive transducers; piezoelectric transducer; semiconductor and other sensing structures. Displacement transducers; tachometers and velocity transducers; accelerometers and gyros; strain gauges; force and torque transducers; flow-meters and level sensors; pressure transducers; sound and ultrasonic transducer. Phototubes and photodiodes; photovoltaic and photoconductive cells, photoemission, photo-electromagnetic, detectors pressure actuated photoelectric detectors, design and operation of optical detectors, detector characteristics.
Transducer Performance : Electrical tests, measurement unit, measurement of voltage, current, frequency, impedance, noise, loading errors, resolution and threshold tests. Calibration, dynamic tests, environmental test, life test.

Application of transducers: Displacement, velocity, acceleration, force, stress, strain, pressure and temperature measurement. Angular and linear encoders, Radar, laser and sonar distance measurement, Tachometers, Viscometer and densitometers.

Text Books

1.	Measurement Systems–Application and Design	E. O. Deobelin	Tata McGraw-Hill
2.	Electronic Instruments and Instrumentation Technology	M. M. S. Anand	Prentice-Hall of India
3.	Modern Electronic Instrumentation and Measuring Techniques	A.D. Helfrick and W.D. Cooper	Pearson Education

References:

1.	Electronic Test Instruments	R. A. Witte	Pearson Education
2.	Instrumentation, Measurement, and Feedback	B. E. Jones	Tata McGraw-Hill
3.	Sensors and Signal Conditioning	R. P. Areny and T. G. Webster	Wiley-Interscience
4.	Electronic Instruments Handbook	C. F. Coombs	McGraw-Hill
5.	Instrument Engineers' Handbook: Process Measurement and Analysis	B. G. Liptak	CRC

EC 1454 ADVANCED TOPICS IN WIRELESS COMMUNICATION (Elective IV) **L T P C 3-0-0-6**

Pre-requisite- Digital Communication.

Introduction: A short history of wireless communication, representation of mobile radio signal. Mobile Radio propagation: Small-scale path loss and fading: Causes, types of fading and classification of channels.

Evolution of Modern Mobile Wireless Communication System: First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Wireless Local Area Networks (WLANs), Cellular –WLAN Integration, All IP Network, Vision for 4G and LTE.

GSM: Architecture and Protocols: Air Interface, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multiframe, Control (Signaling) Channel Multiframe, Frames, Multi-frames, Super-frames and Hyper-frames, GSM Call Set up Procedure, GSM Protocols and Signaling, Location Update Procedure, Routing of a call to a Mobile Subscriber.

2.5G Networks - The General Packet Radio Services: (GPRS): GPRS Networks Architecture, GPRS Interfaces and Reference Points, GPRS Logical Channel, GPRS Mobility Management Procedures, GPRS Attachment and Detachment Procedures, Session Management and PDP Context, Data Transfer Through GPRS Network and Rout, GPRS Location Management Procedures, GPRS Roaming, The IP Internetworking Model, GPRS Interfaces and Related Protocols, GPRS Applications.

Overview of CDMA systems: IS-95 Networks: 3G – The Universal Mobile Telecommunication System (UMTS) - UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution UMTS Release 5, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS downlink transport and physical channels, UMTS uplink transport and physical channels UMTS Time Slots, UMTS Network Protocol Architecture, Mobility Management for UMTS Network.

Overview of WiMAX: IEEE 802.16 and WiMAX, Salient features of WiMAX, WiMAX.

Physical and MAC layer Overview, Advanced features for performance improvement, Handoff Mechanism, Different types of Services, QoS Architecture.

Cellular and WLAN Integration: Heterogeneous Network Architecture, Step towards 4G Networks, introduction to 4G. features and standards, LTE.

Introduction to OFDM: Principle of OFDM, Principles of QAM-OFDM, and Transmission via bandlimited channel, Basic OFDM modem design, OFDM BW efficiency, OFDM Transmission over Gaussian Channel.

SDR: Basic architecture of SDR, Cognitive radio, Spectrum Sensing issues.

Text/Reference Books:

1.	Wireless Communications: Principles and Practice	T. S. Rappaport	Pearson Education Second Edition / Prentice Hall of India, Third Indian Reprint
2.	Wireless Communication Technology	R. Blake	Thomson Delmar
3.	Mobile Communications Engineering: Theory and applications	W. C. Y. Lee	McGraw-Hill International
4.	OFDM and MC-OFDM	L.Hanzo, T. Keller	John Wiley & Sons
5.	Wireless Communication	V.K.Garg	Morgan Kaufmann; 1 edition

EC 1455 **LOW POWER VLSI DESIGN (Elective IV)** **L T P C**
3-0-0-6

Pre-requisite- VLSI

Introduction: Introduction, Motivation for low power design, need and application low power design, Low power design space: voltage, Physical Capacitance, Switching Activity.

Sources of power consumption and Power estimation: Static power and dynamic power: switching component of power, short circuit component of power, leakage component of power and other component of power consumption. Power estimation considering node transition activity factor, glitching effect and glitching power.

Voltage Scaling approaches for low power design: Reliability driven voltage scaling, technology driven voltage scaling, energy-delay minimum based voltage scaling, voltage scaling through threshold reduction, architecture driven voltage scaling.

Adiabatic Switching for low power design: Concept of adiabatic charging, adiabatic amplification. Adiabatic logic gates, stepwise charging, pulsed power supply.

Switching Capacitance minimization for low power design: Algorithmic approaches, Architecture optimization, Logic optimization, Circuit optimization, physical design optimization.

Low power adder design: Introduction, Standard adder: half adder, full adder, CMOS adder architectures: Ripple carry adder (RCA), Carry look- Ahead adder (CLA), Carry Select Adder (CSL), Carry Save Adder (CSA), Carry Skip Adder (CSK), Conditional Sum Adder (COS), Performances of all the adders with low power design, BiCOS adders.

Text/Reference books:

1.	Low Power Digital CMOS Design	Anantha P. Chandrakasan and Robert W. Broderson	Springer
2.	Low Power CMOS VLSI Circuit Design	Kaushik Roy and Sarat C. Prasad	Wiley India Pvt Ltd
3.	Low – Voltage, Low – Power VLSI Subsystems	Kiat-Seng Yeo and Kaushik Roy	TMH

EC 1456 **VLSI FOR SIGNAL PROCESSING AND COMMUNICATION (Elective IV)** **L T P C**
3-0-0-6

Pre-requisite- DSP, Communication, VLSI

Introduction to DSP systems: Introduction To DSP Systems -Typical DSP algorithms; Iteration Bound – data flow graph representations, loop bound and iteration bound, Longest path Matrix algorithm; Pipelining and parallel processing – Pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power.

Retiming: Retiming - definitions and properties; Unfolding – algorithm for Unfolding, properties of unfolding, sample period reduction and parallel processing application; Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT algorithm architecture transformation, parallel architectures for rank-order filters, Odd- Even Merge- Sort architecture, parallel rank-order filters.

Fast convolution: Fast convolution – Cook-Toom algorithm, modified Cook-Took algorithm; Pipelined and parallel recursive and adaptive filters – inefficient/efficient single channel interleaving, Look- Ahead pipelining in first- order IIR filters, Look-Ahead pipelining with power-of-two decomposition, Clustered Look-Ahead pipelining, parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters, pipelined adaptive digital filters, relaxed look-ahead, pipelined LMS adaptive filter.
Bit-level arithmetic architectures: Scaling and roundoff noise- scaling operation, roundoff noise, state variable description of digital filters, scaling and roundoff noise computation, roundoff noise in pipelined first-order filters; Bit-Level Arithmetic Architectures- parallel multipliers with sign extension, parallel carry-ripple array multipliers, parallel carry-save multiplier, 4x 4 bit Baugh-Wooley carry-save multiplication tabular form and implementation, design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement.
Programming digital signal processors: Numerical Strength Reduction – sub expression elimination, multiple constant multiplications, iterative matching. Linear transformations; Synchronous, Wave and asynchronous pipelining-synchronous pipelining and clocking styles, clock skew in edge-triggered single-phase clocking, two-phase clocking, wave pipelining, asynchronous pipelining bundled data versus dual rail protocol; Programming Digital Signal Processors – general architecture with important features; Low power Design – needs for low power VLSI chips, charging and discharging capacitance, short-circuit current of an inverter, CMOS leakage current, basic principles of low power design.

Texts/Reference:

1.	VLSI Digital Signal Processing systems, Design and implementation	Keshab K.Parhi	Wiley, Inter Science
2.	Practical Low Power Digital VLSI Design	Gary Yeap	Kluwer Academic Publishers
3.	Analog VLSI Signal and Information Processing	Mohammed Ismail and Terri Fiez	Mc Graw-Hill
4.	VLSI and Modern Signal Processing	S.Y. Kung, H.J. White House, T. Kailath	Prentice Hall
5.	Design of Analog & Digital VLSI Circuits for Telecommunication and Signal Processing	Jose E. France, Yannis Tsividis	Prentice Hall

EC 1457 **SIMULATION OF DEVICES AND CIRCUITS (Elective IV)** **L T P C**
3-0-0-6

Pre-requisite-Physics of Semiconductor & Devices

Review of Semiconductor Devices: P-N Junction Diode, Schottky diodes, MOS Device operations, Poisson's equation, continuity, drift, diffusion, mobility, trap changes. BJT models – Eber's Moll, Gummel – Poon model.
MOS Models: Model-I, Model-II and Model-III, MESFETs, HEMTs and HBTs.
PSPICE: Introduction – Pspice overview – DC circuit Analysis –AC circuit analysis – Transient and the time domain – Fourier Series and Harmonic components – An introduction to Pspice devices BJT, FET, MOSFET and its model, Amplifiers and Oscillators.
MATLAB simulation for the computation of device characteristics of simple devices.
SUPREM Process simulation

Text/Reference books:

1.	Semiconductor Device modeling with SPICE	Massobrio	TMH
2.	Computer aided analysis of power electronic systems	Rajagopalan. V	Marcel Dekker
3.	Microsim Pspice and circuit analysis	John Keown	Prentice Hall College Div
4.	Introduction to Device Modeling and Circuit Simulation	Tor A. Fjeldly, Trond Ytterdal, and Michael Shur	Wiley-Interscience
5.	Semiconductor Material and Device Characterization	Dieter K. Schroder	Wiley-Interscience

6.	Computer-Aided Circuit Analysis Using PSpice	Walter Banzhaf	Prentice Hall College Div
7.	Device Electronics for Integrated Circuits	Richard S. Muller, Theodore I. Kamins, and Mansun Chan	John Wiley & Sons
8.	Matlab / Simulink manual	Mathworks	

EC 1461 **ADVANCED COMPUTER ORGANIZATION AND ARCHITECTURES** **L T P C**

Pre-requisite- Pulse and Digital Electronic Circuits, Computer Organization and Microprocessors **3-0-0-6**

Overview of von Neumann architecture: Instruction set architecture; The Arithmetic and Logic Unit, The Control Unit, Memory and I/O devices and their interfacing to the CPU; Measuring and reporting performance; CISC and RISC processors.
Pipelining: Basic concepts of pipelining, data hazards, control hazards, and structural hazards; Techniques for overcoming or reducing the effects of various hazards.
Hierarchical Memory Technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.
Instruction-level parallelism: Concepts of instruction-level parallelism (ILP), Techniques for increasing ILP; Superscalar, superpipelined and VLIW processor architectures; Vector and symbolic processors; Case studies of contemporary microprocessors
Multiprocessor Architecture: Taxonomy of parallel architectures; Centralized shared-memory architecture, synchronization, memory consistency, interconnection networks; Distributed shared-memory architecture, Cluster computers.
Non von Neumann Architectures: Data flow Computers, Reduction computer architectures, Systolic Architectures.

Text/Reference books:

1.	Computer Organization and Architecture: Designing for performance	W. Stallings	PHI
2.	Computer Architecture: A Quantitative Approach	J. H. Hennessy and D. A. Patterson	Morgan Kaufmann
3.	Advanced Computer Architecture: Parallelism, Scalability and Programmability	Kai Hwang	McGraw-Hill Inc
4.	Parallel Computer Architecture: A Hardware/Software Approach	D. E. Culler, J. Pal Singh, and A. Gupta	HarcourtAsiaPte Ltd.

EC 1462 **UNDERWATER ACOUSTICS (Elective V)** **L T P C**

3-0-0-6

Pre-requisite- DSP, Instrumentation.

Echo sounder, Underwater communication, Underwater measuring instruments/ calibration, Remote controlled submersibles, Acoustic holography, Low light television, Sonobuoys and underwater weapon control

Text/Reference books:

1.	An Introduction to Underwater Acoustics	Xavier Larton	Springer
2.	Underwater Acoustic System Analysis	William S. Burdic	Prentice Hall

EC 1463 **AUDIO/VIDEO ELECTRONICS AND BROADCASTING (Elective V)** **L T P C**
3-0-0-6

Pre-requisite- Instrumentation.

Audio Engineering: Sound waves, Complex sounds, Audio frequency range, loudness, pitch, and decibels. Sound pick up devices (microphones): types: - condenser- carbon, piezoelectric – direction pattern-parameters of microphones: - frequency range- sensitivity-impedance- noise. Sound reproduction devices: types: - horn, cone – typical specifications-Acoustics of speech production and hearing. Recording of Sound: Magnetic recording systems –optical storage systems-Coding and decoding applied to CD – CD-R.
Video Engineering: Elements of Television System: - Basic Block Schematic of Monochrome TV Transmitter and receiver, Gross structure, flicker & interlaced scanning, number of scanning lines. Horizontal and Vertical resolution, Resolution and Bandwidth. Composite video signal- Vertical and horizontal synchronization, Vestigial Sideband Transmission, transmission of Sound signal. Modulation Positive and Negative Modulation and its comparison - Picture tubes. Television Cameras, Working Principle and operation of CCD cameras.
Colour Television: Compatibility considerations, Colour response of human eye, three colours theory, additive mixing of colours, chromaticity diagram, Luminance and chrominance, Block schematic explanation of Colour TV Cameras. Colour difference signal and its generation. Colour signal transmission, Modulation of colour Difference signals and colour burst signal. Basic Colour Television Systems: PAL, NTSC and SECAM.-Block Schematic, explanation and Comparison. Colour TV picture tubes: CRTs, LCD and Plasma displays.
Audio and Video coding: Introduction to Audio Coding, Audio compression, MPEG – Block diagram of audio encoder and decoder, Digital Audio Broadcasting- Block schematic explanation. Video coding and compression: Need for compression- video image representation – quantization of image data- intra frame compression techniques: DPCM –DCT based transform coding- Motion Compensation –H261 video conference coding standard-MPEG video compression- HDTV- DVB-T.

Text Books:

1.	The Electronics Hand Book edited	JC Whitaker	IEEE Press
2.	Monochrome and Colour Television	RR Gulati	New Asian Age
3.	Multimedia Communications	Fred Halsal	Pearson Education
4.	Discrete Time Speech Signal Processing: Principles and practice	Thomas Quatieri	Pearson Education

References:

1.	Fundamentals of Acoustics	Kinsler, Frey, Coppens	Wiley Eastern
2.	Basic Television Engineering	Bernad Grob	Mcgraw hill
3.	Television and Video Engineering	A M Dhake	McGraw hill
4.	Colour Television	S P Bali	New Age International Publishers
5.	Mastering Digital Television: The Complete Guide to the DTV Conversion	Whitaker, Jerry	McGraw Hill

EC 1464 **TELECOMMUNICATION SWITCHING AND NETWORKS (Elective V)** **L T P C**
3-0-0-6

Pre-requisite- Analog Communication, Digital Communication.

Telecommunication switching systems: Introduction, Elements of switching systems, switching network configuration, principles of cross bar switching, Electronic space division switching, Time division switching, Combination switching.
Telephone networks: Subscriber loop systems, switching hierarchy and routing, transmission plan, numbering plan, charging plans.
Signaling techniques: In channel signaling, common channel signaling. Network traffic load and parameters, grade of service and blocking probability.
Data communication networks: Introduction, network architecture, layered network architecture, protocols, data communications hardware, data communication circuits.
Networking: Public switched data networks, connection oriented & connection less service, Circuit Switching, packet switching and virtual circuit switching concepts, OSI reference model, LAN, WAN, MAN & Internet. Repeaters, Bridges, Routers and gate ways.

Integrated services digital network (ISDN): Introduction, motivation, ISDN architecture, ISDN interfaces, functional grouping, reference points, protocol architecture, signaling, numbering, addressing, BISDN.
DSL technology: ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM & CMTS and DOCSIS.
SONET: Devices, Frame, Frame Transmission, Synchronous Transport Signals, STS I, Virtual Tributaries and Higher rate of service.

Text Books:

1.	Tele communication switching system and networks	Thyagarajan Viswanath	PHI
2.	Advanced electronic communications systems	Wayne Tomasi	PHI

References:

1.	Digital telephony	J. Bellamy	John Wiley
2.	Data Communications & Networks	Achyut. S.Godbole	TMH
3.	Principles of Communication Systems	H. Taub & D. Schilling	TMH
4.	Data Communication & Networking	B.A. Forouzan	TMH
5.	Telecommunication switching, Traffic and Networks	J E Flood	Pearson Education

EC 1465 **RF AND MICROWAVE INTEGRATED CIRCUITS (Elective V)** **L T P C**
3-0-0-6

Pre-requisite- Electrical Network Analysis, Electronic Devices, Electromagnetic Engineering and Electronic Circuits

Introduction: Lower Frequency Analog Design and Microwave Design Versus Radio Frequency Integrated Circuit Design, RFIC used in a Communication Transceiver, Review of Transmission Line Theory, Distributed Transmission Lines, Smith Chart, Impedance Matching, Microstrip and Coplanar Waveguide Implementations, S Parameters, Components and Interconnects at High frequencies.
Issues in RFIC Design: Noise – Thermal Noise, Noise Power, Noise Figure, Phase Noise; Linearity and Distortion in RF Circuits – Third Order Intercept Point, Second Order Intercept Point, 1-dB Compression Point, Relationships between 1-dB compression point and IP3 Points, Broadband Measures of Linearity; Modulated Signals – PM, FM, MSK, QAM, OFDM.
LNA Design: Basic Amplifiers, Feedback Techniques, Noise in Amplifiers, Linearity in Amplifiers, Stability Analysis, Differential Amplifiers, Low Voltage Topologies and Use of on-chip Transformers, DC Bias, Broadband LNA Design, CMOS LNA Example.
Mixers: Basic Mixer Operation, Transconductance Controlled Mixer, Double Balanced Mixer, Mixer Noise, Linearity, Isolation, Genera Design Comments, Image Reject and Single-Sideband Mixer, Alternative Mixer Designs, CMOS Mixer Example.
Voltage Controlled Oscillators: LC Resonator, Analysis of Oscillator as Feedback System, Negative Resistance Oscillator, Differential Topologies, Colpitts Oscillator, Phase Noise Reduction Techniques, Quadrature Oscillators and Injection Locking. CMOS Example.
Frequency Synthesis: PLL Components, Continuous Time Analysis of PLL Synthesizers, Discrete Time Analysis for PLL Synthesizers, Transient Behaviors, Fractional – N PLL Frequency Synthesizers, CMOS Example.
Power Amplifiers: Introduction, Power Capability, Efficiency, Matching Considerations, Class A,B,C,D,E,F,G amplifiers, AC Load line, Transistor Saturation, Power Combining Techniques, Effects and Implications of Nonlinearity – Cross Modulation, AM – PM Conversion, Spectral Regrowth, Linearization Techniques, Feedforward, Feedback, Predistortion, CMOS Power Amplifier Example.

Text/Reference books:

1.	The Design of CMOS Radio-Frequency Integrated Circuits	Thomas H. Lee	Cambridge University Press
2.	Radio Frequency Integrated Circuit Design	Rogers and Plett	Artech House Publishers
3.	RF Power Amplifiers for Wireless Communications	Steve C. Cripps	Artech House Publishers

4.	Analysis and Design of Analog Integrated Circuits	Gray, Hurst, Lewis & Meyer	Wiley India Pvt Ltd
5.	Design of Analog CMOS Integrated Circuits	B. Razavi	TMH

EC 1466 **TOPICS IN INFORMATION SECURITY (Elective V)** **L T P C**
3-0-0-6

Pre-requisite- Computer Networks, Information Theory Coding & Cryptography

Introduction To Security: Need for security, Security approaches, Principles of security, Types of attacks.
Cryptographic Techniques: Plaintext, Cipher text, Substitution & Transposition techniques, Encryption & Decryption, Types of attacks, Key range & Size.
Symmetric & Asymmetric Key Cryptography: Algorithm types & Modes, DES, IDEA, Differential & Linear Cryptanalysis, RSA, Symmetric & Asymmetric key together, Digital signature, Knapsack algorithm.
User Authentication Mechanism: Authentication basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall.
Case Studies of Cryptography: Denial of service attacks, IP spoofing attacks, Secure inter branch payment transactions.

Text/Reference books:

1.	Cryptography & Network Security	Atul Kahate	TMH
2.	Computer Networks	A.S Tanenbaum	Pearson

EC 1467 **ADHOC AND SENSOR NETWORKS (Elective V)** **L T P C**
3-0-0-6

Pre-requisite- Computer Networks

Introduction of ad-hoc/sensor networks: Key definitions of ad-hoc/sensor networks, Advantages of ad-hoc/sensor networks, Unique constraints and challenges, Driving Applications.
Wireless Communications/Radio Characteristics
Ad-Hoc wireless networks
Media Access Control (MAC) Protocols: Issues in designing MAC protocols, Classifications of MAC protocols, MAC protocols.
Routing Protocols: Issues in designing routing protocols, Classification of routing protocols, Routing protocols.
Networking Sensors: Unique features, Deployment of ad-hoc/sensor network, Sensor tasking and control, Transport layer and security protocols.
Sensor Network Platforms and Tools : Sensor network programming challenges, Embedded Operating System.
Applications of Ad-Hoc/Sensor Network and Future Directions: Ultra wide band radio communication, Wireless fidelity systems.

Text/Reference books:

1.	Adhoc Sensor Network Theory and applications	Dharma Prakash Aggarwal	World Scientific Publishing Company
2.	Wireless Sensor Networks	Karl and Willig	Willey publication Ltd
3.	Adhoc Wireless Network	Murthy	Pearson publication

EC 1481 **OPTIMIZATION METHODS IN ENGINEERING** **L T P C**
(Open Elective II) **3-0-0-6**

Pre-requisite- Mathematics (NA)

Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Function.
Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg-Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Liner Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real-Time Optimization, Optimization in Econometrics Approaches.
Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Euler's Method, The Modified Euler Method and the Runga-Kutta Method for Ordinary Differential Equations, Gaussian Quadrative Tranzoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration.
Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maximum Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods.

Text/Reference books:

1.	Optimization Theory and Applications	S S Rao	Wiley
2.	Optimization for Engineering Design- Algorithms and Examples	K Deb	PHI
3.	Engineering Optimization- Methods and Applications	G V Reiklaitis, A Ravindran and M Rangsdell	Wiley

EC 1482 **MACHINE INTELLIGENCE (Open Elective II)** **L T P C**
3-0-0-6

Pre-requisite-Probability and statistics, Image Processing

Introduction: Basic concepts of pattern recognition and its representation, machine perception.
Fuzzy sets and relations: Basic concepts, conventional sets, fuzzy sets, membership functions, operations on fuzzy sets, fuzzy logic and approximate reasoning.
Supervised classification: Bayes Rule, Bayes classifier, minimum risk classifier, minimum distance classifier, PDF estimation from samples, Linear discriminator, Perceptron criterion, MSE criterion, Multi class classification, Keslers construction, Ho-Kashyap procedure; Support Vector Machine (SVM).
Un-supervised classification: Nearest neighbor, KNN classifier, MSE clustering, k-means clustering, fuzzy k-means clustering.
Reinforcement learning: basic fundamentals, Q-learning, multi-agent reinforcement learning
Neural Pattern Recognition: Probabilistic neural network, multi-layer perceptron
Image understanding: Review of segmentation, Image component description boundary representation, region representation.
Image component representation: feature vector representation, graphical representation; Image Interpretation: Pattern recognition techniques, graphical techniques.

Text/Reference books:

1.	Pattern classification	R. O. Duda, P. E. Hart, D. G. Stork	John Wiley and Sons, 2001
2.	Pattern recognition and machine learning	C. M. Bishop	Springer, 2006
3.	Computational Intelligence: principles, techniques, and applications	A. Konar	Springer, 2005

EC 1483 **HUMAN COMPUTER INTERFACE (Open Elective II)** **L T P C 3-0-0-6**

Pre-requisite- Digital Signal Processing, Digital Speech Processing, Digital Image Processing

Introduction: Importance of user Interface – Definition, Importance of good design, Benefits of good design, A brief history of Screen design.
The graphical user interface: Popularity of graphics, The concept of direct manipulation, Graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.
Design process: Human interaction with computers, Importance of human characteristics human consideration, Human interaction speeds, Understanding business junctions.
Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.
Windows: New and Navigation schemes selection of window, selection of devices based and screen based controls.
*Components:*Text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.
Software tools: Specification methods, interface – Building Tools.
Interaction Devices: Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.

Text Books:

1.	The essential guide to user interface design	Wilbert O Galitz	Wiley DreamTech
2.	Designing the user interface. 3rd Edition	Ben Shneidermann	Pearson Education, Asia

Reference Books:

1.	Human – Computer Interaction	Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg	Pearson Education
2.	Interaction Design	Prece, Rogers, Sharps	Wiley Dreamtech
3.	User Interface Design	Soren Lauesen	Pearson Education

EC 1484 **NANOTECHNOLOGY (Open Elective II)** **L T P C 3-0-0-6**

Pre-requisite- Physics, Analog IC & Technology.

Introduction to Quantum Mechanics: Introduction, matter waves, Heisenberg's Uncertainty Principle, Schrodinger equation, Electron Confinement, Tunnelling of a particle through Potential barrier.
Structure and bonding: Arrangement of atoms, Two dimensional Crystal Structures, Three dimensional Crystal Structures, Some example of Three dimensional crystals, planes in crystal, Crystallographic Directions, Reciprocal Lattice, Quasi crystal, Bonding in solid, electronic structure of solids.
Synthesis of Nanomaterials: Mechanical methods- Methods based on evaporation, sputter Deposition, Chemical Vapour Deposition, Ion beam technique, Molecular beam epitaxy.
Chemical methods: Colloids and colloids in Solutions, growth of Nanoparticles,
Biological methods: Synthesis using Microorganism, Synthesis using plant Extracts.
Analysis techniques: Microscopes, Electron Microscopes, Scanning Probe Microscopes, diffraction Techniques, Spectroscopies, Magnetic measurement.
Properties of nano material: Mechanical properties, Structural properties, Melting of nanoparticles, Electrical conductivity, Optical properties, Magnetic properties.
Some special nano material: Carbon nano tubes, Porous Silicon, Aerogels, Zeolites, self assembled Nanomaterials.
Applications: Electronics, Sports and toys, Textiles, Cosmetics, Biotechnology and medical field, Space and defense.

Text/Reference books:

1.	Nano- The Next Revolution	Mohan Sunder Rajan	NBTI
2.	Introduction To Nano Technology	Charles P. Pode	Springer
3.	Quantum Dot Heterostructures	D.Bimberg,M.Grundman	John Wiley & Sons
4.	Light and Matter	Yehuda Band	John Wiley & Sons
5.	NanoPhotonics	Paras N. Prasad	John Wiley & Sons
6.	Quantum Dot Heterostructures	D.Bimberg, M.Grundman, N.N. Ledenstov	John Wiley & Sons
7.	Advances in Nano Science and Technology	Sharma Ashutosh, Jayesh	National Institute of Science Communication and Information Resources, Council of Scientific & Industrial Research, 2004

Course Structure for B. Tech. (4 year, 8 Semester Course) Electrical Engineering

(to be applicable from 2012 entry batch onwards)

Course No.	Course Name	L	T	P	C	Course No.	Course Name	L	T	P	C
Semester - 1						**Semester - 2**					
CH-1101/ PH-1101	Chemistry/Physics	3	1	0	8	EC-1101	Basic Electronics	3	0	0	6
EE-1101	Basic Electrical Engineering	3	0	0	6	CS-1101	Introduction to Computing	3	0	0	6
MA-1101	Mathematics – I	3	1	0	8	MA-1102	Mathematics - II	3	1	0	8
CE-1101	Engineering Graphics	1	0	3	5	ME-1101	Engineering Mechanics	3	1	0	8
HS-1101	Communication Skills	3	0	0	6	PH-1101/ CH-1101	Physics /Chemistry	3	1	0	8
CH-1111/ PH-1111	Chemistry/Physics Laboratory	0	0	2	2	CS-1111	Computing Laboratory	0	0	2	2
ME-1111	Workshop	0	0	3	3	EE-1111	Electrical Science Laboratory	0	0	2	2
	Physical Training-I	0	0	2	0	PH-1111/ CH-1111	Physics/Chemistry Laboratory	0	0	2	2
	NCC/NSO/NSS	0	0	2	0		Physical Training-II	0	0	2	0
		13	**2**	**8**	**38**		NCC/NSO/NSS	0	0	2	0
								15	**3**	**6**	**42**
Semester - 3						**Semester - 4**					
MA-1201	Mathematics – III	3	1	0	8	EE-1205	Power System-I	3	1	0	8
EE-1201	Circuits and Networks	3	1	0	8	EE-1206	Signals and Systems	3	1	0	8
EE-1202	Electromagnetic Field Theory	3	0	0	6	EE-1207	Electrical Machines-I	3	1	0	8
EE-1203	Analog Electronics	3	1	0	8	EE-1208	Digital Electronics	3	0	0	6
EE-1204	Electrical Measurement and Measuring Instruments	3	0	0	6	HS-1201	Managerial Economics	3	0	0	6
EE-1211	Measurement Laboratory	0	0	2	2	EE-1213	Analog and Digital Electronics Lab	0	0	2	2
EE-1212	Network Theory Laboratory	0	0	2	2	EE-1214	Software Engineering Lab	0	0	2	2
	Physical Training-III	0	0	2	0		Physical Training-IV	0	0	2	0
	NCC/NSO/NSS	0	0	2	0		NCC/NSO/NSS	0	0	2	0
		15	**3**	**4**	**40**			**15**	**3**	**4**	**40**
Semester - 5						**Semester - 6**					
EE-1301	Electrical Machines-II	3	1	0	8	EE-1305	Control System-II	3	1	0	8
EE-1302	Control System-I	3	1	0	8	EE-1306	Power Electronics	3	1	0	8
EE-1303	Power System-II	3	0	0	6	EE-1307	Switchgear & Industrial Protection	3	0	0	6
EE-1304	Microprocessor & Microcontroller	3	0	0	6	EE-1308	Programming and Data Structure	3	0	0	6
EE-1311	Electrical Machines Lab-I	0	0	2	2	EE-1309	Instrumentation	3	0	0	6
EE-1312	Control System Laboratory	0	0	2	2	EE-1314	Electrical Machines Lab-II	0	0	2	2
EE-1313	Power System Laboratory	0	0	2	2	EE-1315	Process Control & Instrumentation Laboratory	0	0	2	2
		12	**2**	**6**	**34**	EE-1316	Microprocessor & Microcontroller Laboratory	0	0	2	2
								15	**2**	**6**	**40**
Semester - 7						**Semester - 8**					
EE-1401	Digital Signal Processing	3	0	0	6	EE-1403	Analog & Digital Communications	3	0	0	6
EE-1402	Industrial Drives	3	0	0	6	EE-1xxx	Departmental Elective - III	3	0	0	6
EE-1411	Power Electronics & Drives Lab	0	0	2	2	EE-1xxx	Departmental Elective - IV	3	0	0	6
EE-1xxx	Departmental Elective - I	3	0	0	6	EE-1xxx	Departmental Elective - V	3	0	0	6
EE-1xxx	Departmental Elective - II	3	0	0	6	XX-1xxx	Open Elective - II	3	0	0	6
xx-1xxx	Open Elective - I	3	0	0	6	EE-1491	Project - II	0	0	10	10
EE-1490	Project - I	0	0	8	8			**15**	**0**	**10**	**40**
		15	**0**	**10**	**40**						

LIST OF ELECTIVES:

Departmental Electives I

EE 1421	High Voltage AC/DC
EE 1422	Power Electronics in Power Systems
EE 1423	High Power Semiconductor Devices
EE 1424	Digital Control Systems
EE 1425	Electrical Engineering Materials
EE 1426	Smart Grid
EE 1427	Industrial Management

Departmental Electives II

EE 1431	Computer Applications in Power System
EE 1432	Computer Aided Design of Electrical Systems
EE 1433	Intelligent Algorithms for Power Systems
EE 1434	Advanced Power Electronics and Devices
EE 1435	Advanced Engineering Mathematics
EE 1436	Integrated Circuits and VLSI Design
EE 1437	Process Control

Departmental Electives III

EE 1441	Restructured Electrical Power System
EE 1442	Electrical Networks and Pricing
EE 1443	Electric Power Utilization and Traction
EE 1444	Smart Sensors
EE 1445	Opto Electronics and Fiber Optics
EE 1446	Wind and Solar Energy Systems
EE 1447	Intelligent Control
EE 1448	Switched Mode Power Conversion

Departmental Electives IV

EE 1451	Distribution System Planning and Automation
EE 1452	Demand Side Management
EE 1453	Modeling, Analysis and Control of Electrical Machines
EE 1454	Modeling and Simulation
EE 1455	Illumination Technology
EE 1456	Renewable Energy Sources and Management
EE 1457	Nonlinear Control Systems

Departmental Electives V

EE 1461	Power Quality
EE 1462	Power System Reliability
EE 1463	Foundation in Optimization Methods
EE 1464	Industrial Instrumentation
EE 1465	Biomedical Engineering
EE 1466	Hydro-Electric Engineering
EE 1467	Advanced Control Systems
EE 1468	Power Electronic Control of AC Drives

Open Elective I

EE 1471	Soft Computing Techniques and Applications
EE 1472	Data Warehousing and Data Mining
EE 1473	Neural Networks and Fuzzy Logic
EE 1474	Evolutionary Algorithms in Search & Optimization
EE 1475	Information Securities
EE 1476	Data Based Management System
EE 1477	Control Systems Design

Open Elective II

EE 1481	Finite Element Methods in Engineering
EE 1482	Human-Computer Interface
EE 1483	Machine Intelligence
EE 1484	Intelligent and Knowledge Based Systems
EE 1485	Computer Organization & Architecture
EE 1486	Extra High Voltage Transmission
EE 1487	Control Systems Components

EE 1101	BASIC ELECTRICAL ENGINEERING	L	T	P	C
	1st Semester	2	1	0	6
	All Branch				

Prerequisite: None

Introduction: Definition of active, passive, linear, non-linear, unilateral, bilateral, symmetrical, unsymmetrical network with example. Basic concept of circuit elements and their uses. Sources: current sources and voltage sources, dependent source, independent source, circuit laws (KCL & KVL), commonly used symbol and notations in electrical circuits; Introduction to lead acid battery. (3)

A.C. Fundamentals: Equation of AC Voltage and currents, waveform, time period, frequency, amplitude, different forms of emf equations, phase, phase difference, average value, RMS value, form factor, peak factor. Operator j, notation of complex quantity in rectangular and Polar form. Concept of Impedance and admittance: definition, relation, impedance, and admittance triangle. Complex power: active, reactive and apparent power, power triangle. (4)

R.L.C. Circuit: Series and parallel RL, RC, and RLC circuits and their phasor representation; steady state response; (4)

Network Theorems: Thevenin's Theorem (AC & DC), Norton's Theorem (AC & DC), Superposition Theorem (AC & DC), Maximum power transfer theorem (DC), Node & loop equations, Star delta conversions.(5)

Poly-phase Networks: Balanced Star-Delta connections, phase and line currents and voltages and their relations; (2)

Electromechanical Energy conversion: Electromechanical laws: relation between electricity and magnetism, production of emfs (ac & dc), Faraday's law of electromagnetic induction, direction of induced emf, Lenz law, dynamically and statically induced emfs, self-inductances, and mutual inductances. (3)

Electrical Machines: Types of Electrical Machines and their uses; Working principle of DC motor, 1-phase transformer, and 3-phase induction motor; EMF equation, (5)

Reference Books:

S. N.	Author	Name of Book	Publisher
1	Del Toro V.	Electrical Engineering Fundamentals	PHI
2.	Theraja B. L.	Electrical Technology	S Chand
3.	Hayt W. H., Kemmerly J. E.	Engineering Circuit Analysis	McGraw Hill
4.	Boylstad R. E., Nashelsky L.	Electronic Devices and Circuit Theory	PHI
5.	H. Cotton	Electrical Technology	PHI

EE 1201 | **CIRCUITS AND NETWORKS** | **L T P C**

3rd Semester | **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Basic Electrical Engineering (EE 1101), Mathematics I, Mathematics II

1. **Revision on Network Theorems:** Superposition theorem, maximum power transfer theorem, reciprocity theorem, Millman's theorem, substitution theorem, compensation theorem, Tellegen's theorem, all theorems using examples of AC networks.
2. **Two Port Network:** One port and two port network, Sign convention, Admittance Parameter, Parallel connection of two port network, Impedance parameter, Series connection of two-port network. Hybrid parameters, Inverse Hybrid parameters, Transmission parameters, Inverse Transmission parameters, Concept of driving point impedance and admittance, Symmetrical two ports and bisection, Image impedance.
3. **Magnetically Coupled Circuit:** Mutual inductance, Coupling Co-efficient K, Dot rule for coupled coils, Analysis of coupled circuits, The T-equivalent network of the transformer.
4. **Graph Theory :** Graph of a network, Trees, Co-trees, Loops, Incidence matrix, cut-set matrix, Tie matrix and loop currents, Number of possible trees of a Graph, Analysis of Networks, Network Equilibrium Equation, Duality, General network transformation.
5. **Application of Laplace Transform:** Brief review of Laplace transform technique, Initial and final value Theorem, Solution of circuit transient using Laplace transform. Use of Laplace's transform in electrical circuit analysis.
6. **Frequency Response:** Concept of complex frequency, The complex frequency plane, Concept of Pole and Zero, Plot of Poles and Zeros of simple RL, RC and RLC circuit connected in series and parallel, polar plot, Concept of resonance, series and parallel resonance, Q factor, half power frequency, Concept of transfer function of a network.
7. **Fourier Analysis:** Trigonometric Fourier Series, Evaluation of Fourier Coefficients, Waveform Symmetry, Exponential form, Fourier transform techniques applied in networks.
8. **Filter Circuits:** Classification of filters, equation of an ideal filter, Theory of pie section, Constant K-type filters, low pass filters, design of low pass filter, high pass filters, band pass filters, band rejection filters and all pass filters. M derived filters, theory of M-derived filters, M-derives low pass and high pass filters. Approximation theory of filters (Butterworth and Chebyshev).

Reference Books:

S.N.	Author	Title	Publisher
1.	Hayt&Kemmerly	Engineering Circuit Analysis	McGraw Hill
2.	Roy Choudhury	Network and Systems	New Age
3.	Rajeswaran	Electric Circuit theory	Pearson
4.	Wadhwa	Network Analysis and Synthesis	New Age
5.	Soni& Gupta	A Course in Electrical Circuit Analysis	DhanpatRai& Sons
6.	Van Valkenburg	Network Analysis and Synthesis	PHI

EE 1202 **ELECTROMAGNETIC FIELD THEORY** **L T P C**

3rd Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Mathematics I Mathematics II

1. **Vector Analysis:** Introduction, co-ordinate–system transformation, vector calculus, Divergence of vector and Divergence theorem, curl of a vector and Stokes theorem, Laplacian of a scalar, classification of vector fields.
2. **Electrostatics:** Coulomb's law, Electric field strength, field due to a line charge, sheet charge and volume charge. Electric flux-density, Gauss's law (Maxwell's first equation in electrostatics), applications of Gauss's law. Electric Potential and potential difference, Potential of a point charge and system of charges, Conservative property, potential gradient, dipole. Energy density in electrostatic field.
3. **Magnetostatics:**Biot-Savart's law- magnetic field due to filamentary current, distributed current surface and volume currents. Ampere's circuital law, Scalar and vector magnetic potentials. Maxwell's equations for steady magnetic fields, force on a current element in a magnetic field. Force between two current elements and torque in a current loop.
4. **Electromagnetic Field:** Faraday's law, Lorentz-force equation, displacement current and modified Ampere's circuital law in integral form. Continuity equation. Power flow in electromagnetic field - the Poynting theorem, sinusoidally time-varying fields and its Maxwell's equation. The retarded potentials , polarization of vector fields.
5. **Materials and Fields:** Current and current density. Conductors in fields- drift velocity, mobility, conductivity. Dielectrics in fields- polarization, flux-density, electric susceptibility, relative permittivity. Magnetic materials, magnetization, permeability and magnetic boundary conditions.
6. **Electromagnetic Waves:**Helmontz equation, radiation of electromagnetic waves. Wave motion in free space, perfect dielectric, lossy dielectric, propagation in good conductors-skin effect. Reflection of plane waves.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Mathew N.O. Sadiku	Elements of Electromagnetics	Oxford Univ Press
2.	N.N. Rao	Basic electromagnetic and applications	McGraw Hill
3.	Hayt	Engineering Electromagnetics	
4.	Bradshaw and Byatt.	Introductory Engineering Field Theory	Prentice Hall

EE 1203 **ANALOG ELECTRONICS** **L T P C**

3rd Semester **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Basic Electrical Engineering (EE 1101)

1. **Review of PN Junction Diode**: Properties, diode V-I Characteristics, cut-in potential, reverse saturation, peak-inverse voltage (PIV), diode forward resistance. Diode as a rectifier half-wave and full-wave, rectifier efficiency
2. **Linear Wave Shaping**: Response to sinusoidal, step, pulse, exponential and Ramp input to high pass and low pass circuits.
3. **Bipolar Junction Transistor**: Transistor action, Biasing, bias stability, the operating point, effect of temperature on Q-point, stability factor. BJT in different modes of operation: as a switch, as an amplifier.

4. **MOSFET:** Circuits at DC. MOSFET and BJT as amplifier. Biasing MOS and BJT amplifiers. Small signal operation and models for MOSFET and BJT. Single stage MOS amplifiers and BJT amplifiers.
5. **BJT configuration**: CE, CB and CC configurations. Hybrid-π model of transistor in CE mode, conductance, capacitance, short-circuit current gain, CE current gain with resistive loads, CE stage as an amplifier and Frequency response.
6. **Multi-stage Transistor Amplifiers**, Analysis of CE- CE, CE-CC and CE-CB stages, Darlington pair, Millers Theorem.
7. **Operational Amplifiers**: Basic building block, Differential stage, gain stage, CMRR, Op-Amps as inverting, non-inverting amplifiers, buffers. Applications of Op-Amps: as adder, subtractor, integrator, differentiator, and Logarithmic functions. Use of Op-Amp as comparators, zero-crossing detectors and as active filters.
8. **Introduction to Feedback Amplifiers:** classification and basic concepts of feedback amplifiers. Loop gain. Stability problem. Basic principle of sinusoidal oscillators. RC oscillator. LC and crystal oscillator.

Reference Books:

S N	Author	Name of Book	Publisher
1.	Millman& Gravel	Microelectronics	Tata-McGraw Hill
2.	A. S. Sedra and K. C. Smith	Microelectronic Circuits	Oxford University Press, 5th Edition
3.	D. L. Schilling and C. Belove	Electronic Circuits	Tata McGraw Hill, 3rd Edition
4.	Robert L. Boylestad	Electronic Devices and Circuit Theory	Pearson, 8th Edition

EE 1204 ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS L T P C

3rd Semester 3 0 0 6

Electrical Engineering Branch

Prerequisites: Basic Electrical Engineering (EE 1101)

1. **Introduction**: Introduction of signals, Measurement and instruments, Static and dynamic characteristics of instruments. Different types of instruments. Operating forces required for working of indicating instruments. Different types of damping and control systems. Construction and working principles of PMMC, MI, Induction type, Electrodynamometer type, their applications, advantages and disadvantages.
2. **Galvanometers and Dynamics**: Dynamic behaviour of Galvanometer - equation of motion for different damping conditions. Response of galvanometer, operational constants, CDRX, relative damping, logarithmic decrement, sensibility. Ballistic Galvanometer and Flux meter construction and theory of operation.
3. **Magnetic Measurements:** Magnetic measurements, types of tests, Ballistic tests, measurement of flux density, determination of B.H. curve
4. **Bridges for Measurements**: Measurement of resistance (low) by kelvins Double Bridge Method, insulation resistance by loss of charge method. A.C. & D.C. bridges - Maxwell's commutated D.C. bridge, Anderson bridge, Schering Bridge, Hays Bridge, Wagner Earthing device, Campbell's Mutual Inductance Bridge, Circuit diagram, phasor diagram, derivations of equations for unknown, O-factor, dissipation factor. Advantages and disadvantages.
5. **Potentiometers**: Standardization, Principle of working and construction of Crompton (D.C.) potentiometer, Polar and Co-ordinate type of potentiometers.
6. **Measurement of Power, Power Factor and Energy**: Measurement of power and energy, use of Current transformer and potential transformer, Electrodynamometer type of Wattmeter, Induction type energy meter, Indicating type Frequency meter, Electrodynamometer type P.F. meter.

Reference Books:

SN	Author	Name of Book	Publisher
1.	A.K. Sawhney.	Electrical & Electronics Measurements and Instrumentation	DhanpatRai and Sons
2.	Golding.	A Text Book of Electrical Measurement and Measuring Instruments	Wheeler Publications

EE 1211 **MEASUREMENT LABORATORY** **L T P C**

3rdSemester **0 0 2 2**

Electrical Engineering Branch

Prerequisite: Electrical Measurement and Measuring Instruments (EE1204)

1. To calibrate a three phase Energy Meter by comparing with a Sub – standard meter.
2. Measurement of Power and Power Factor of a three phase circuit.
3. Measurement of Power in HV circuit using instrument transformer (CT & PT)
4. To measure high resistance by loss of charge method.
5. To calibrate Single – phase Energy meter by comparing with a substandard meter and also by calculation.
6. To measure medium resistance with the help of Wheatstone bridge.
7. To measure the low resistance by using Kelvin Double Bridge Method.
    a. To measure the Medium resistance using Substitution Method.
    b. To measure the value of Earth – Resistance.
8. To measure self-inductance of a coil using A.C Anderson's Bridge.
9. To measure capacitance of a given capacitor.
10. To determine the phase sequence of a three phase supply using phase sequence indicator.

EE 1212 **NETWORK LABORATORY** **L T P C**

3rd Semester **0 0 2 2**

Electrical Engineering Branch

Prerequisite: Circuits and Networks (EE 1201)

Hardware Based Experiments:

1. Measurement of active power and power-factor of a parallel R-C load using three ammeters.
2. Measurement of active power and power-factor of a series R-L load using three voltmeters.
3. Measurement of self-inductance of a coil with air and iron as core material separately.
4. Verification of Thevenin's and Norton's theorem in a dc network.
5. Verification of Maximum power transfer theorem in a dc network.
6. Familiarization with a single phase wattmeter.
7. Measurement of power supply frequency with the help of a series RLC tuning circuit.

8. Calibration of a miliammeter as a voltmeter.

Software Based Experiments:

1. Generation of standard analog and digital signals using MATLAB.

2. To find Laplace transform of a system and its inverse using MATLAB.

3. Transient and steady state analysis of networks using PSPICE.

EE 1205	POWER SYSTEM-I	L T P C
	4th Semester	3 1 0 8
	Electrical Engineering Branch	

Prerequisites: Basic Electrical Engineering (EE 1101), Circuits and Networks (EE 1201), Electromagnetic Field Theory (EE 1202)

1. **Introduction to Power Plants:** Introduction to conventional sources (Fuel (Coal, Oil, Gas), atomic (Nuclear), water) and non-conventional sources of energy (Solar, wind, Geothermal, Ocean thermal, Tidal power, Magneto Hydrodynamic (MHD) and Biogas); their scopes for energy conversion. Power Plants (Conventional): Introduction to thermal, hydro, Nuclear, Diesel Electric and Gas turbine Power plants, different types of plants, Selection of sites for each plant, Schematic diagram and working principle of each plant, components of each plant and their functions, Efficiency of each plant. Power Generation (Non-conventional): Schematic diagram of Solar, wind, Geothermal, Ocean thermal, Tidal power, Magneto Hydrodynamic (MHD) and Biogas and working principles. Per unit values for steady state condition, Single line diagram.

2. **Economics of Power Systems:** Definitions of Load, connected load, demand, Peak load, Demand intervals, Demand factor, Average load, load factor, Diversity factors, Utilization factor, capacity factor, load curves, base load, and peak load. Calculations based on the above factors. Economics of power factor improvement. Tariffs: Structures, Calculation on Tariff and economics of power factor improvement.

3. **Transmission Systems:** Introduction to transmission system (TS); Transmission voltages; classification of TS, advantages of High voltage transmission; comparison of Overhead and underground supply system; Comparison of AC and DC transmission system; Introduction to high voltage DC transmission (HVDC) and Flexible AC transmission system (FACTS); Comparison of conductor materials of various overhead systems; Economic choice of conductor size, Kelvin's law.

4. **Distribution Systems:** Introduction to distribution system (DS); Classification of DS; Feeders, distributors, service mains of a typical DS; Classification of AC DS; Connection schemes of DS; Methods of calculations of AC DS; Current loading and voltage drop diagram.

5. **Line Constants:** Introduction to overhead line (OHL) constants; Copper cross section, conductor materials, Resistance: Resistance of OHL, Calculations of resistance; Inductance: Inductance of solid cylindrical conductor, composite conductors, two conductor single phase line, three phase single circuit and double circuit lines with symmetrical and unsymmetrical spacing, transposed and un transposed line, Skin and proximity Effects; Capacitance: Concept, Potential difference between two points due to charge, Capacitance of two wire line, three phase symmetrical and unsymmetrical line, Charging current, Effect of earth on capacitance of transmission line.

6. **Mechanical Design:** Introduction to Mechanical design; Towers: Classification; Design; Cross arm: Functions, types; Insulators: Functions, types; Vibration damper; Guy wires; turn buckle; Danger plat etc. Calculation of sag, ice and wind loading; Stringing chart, Sag template; Voltage distribution of over suspension insulators, string efficiency, Methods of improving string efficiency; Corona: Disruptive critical and visual critical voltages, Factors effecting corona, Corona power loss; advantages and disadvantages of corona, radio interference, induction interference between power and communication lines.

7. **Underground Cables:** Insulator materials; Construction of single core and three core cables; classification of cables and their construction; laying of cables; jointing of cables; Stress and capacitance of single core and three core cables; Most economical size of conductor; Grading of cables; Types of grading; Breakdown voltages and mechanism of breakdown, thermal characteristics of cables.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	C.L. Wadhwa	Electrical Power systems	Wiley Eastern
2.	AshfaqHussain	Electrical Power System	CBS Publishers
3.	B.R.Gupta	Generation of Electrical Energy	S. Chand.
4.	Soni, Gupta, Bhatnagar	Electric Power	DhanpatRai& Sons
5.	J.B.Gupta	A course in Power Systems	S. K. Katia & Sons
6.	O.I.Elgerd	Electric Energy system Theory – An Introduction	Tata McgrawHilll

EE 1206 **SIGNALS AND SYSTEMS** **L T P C**

4th Semester **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Mathematics II , Mathematics III

1. **Introduction to signals and systems**: Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable.

2. **Introduction to system:** properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions. Impulse response of a physical system, introduction to convolution, system impulse response and convolution integral, numerical convolution. Sampling theorem, Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform.

3. **Representation of signals** in terms of elementary signals, condition for orthogonality, representation of signals by elementary sinusoids, Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.

4. **Statistical Signal Analysis**: Classification of random signals, auto correlation function, properties of auto correlation function, measurement of auto correlation function, application of autocorrelation functions, cross correlation functions, properties of cross correlation functions, sum of random processes**.** Spectral density, relation of spectral density to autocorrelation function. Auto correlation function of system output, cross-correlation between input and output, white noise, generation of pseudo-random binary noise, analysis of linear systems in time domain using white noise, mean and mean square value of system output, analysis in the frequency domain.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Gabel R.A. and Robert R.A	Signals and Linear Systems	John Wiley and Sons, New York
2.	Oppenheim, Wilsky and Nawab	Signals and Systems	Prentice Hall, New Delhi
3.	C.T.Chen	Systems and Signal Analysis	Oxford University Press, New Delhi
4.	Cooper G.R and McGillem C.D	Probabilistic Methods of Signals and System Analysis	Oxford University Press, Cambridge
5.	Ziemer R.E., Tranter W.H., and Fannin D.R.	Signals and Systems	Pearson Education Asia, Singapore

EE-1207	ELECTRICAL MACHINES-I	L T P C
	4th Semester	3 1 0 8
	Electrical Engineering Branch	

Prerequisites: Basic Electrical Engineering (EE 1101)

Part-I (15 Lectures, 30 Marks)

1. Constructional features: Magnetic circuit: Different types of field and armature structures, their placement and magnetic path with special reference to transformer. Material used: laminations, magnetic saturation. Arrangements in Transformer, DCM, SM, IM, LIM.

2. Electric circuit: Different types of field and armature windings, pole formation, and winding parameters (full pitch & short pitch) concentrated winding and distributed winding, single layer and double layer winding). Brush slip ring & commutator arrangement. Arrangements in Tr., DCM, IM, LIM, SM.

3. Insulation system: material used, class of insulation.

4. Cooling circuit: Cooling arrangement, medium used for cooling.

5. Magneto-motive force: Nature of MMF developed by concentrated winding carrying DC and AC, their Fourier series components, Nature of mmf due to distributed winding, harmonic reduction, Flux density distribution as a function of path reluctance, main flux and leakage flux, Equation for the instantaneous value of flux linked by a concentrated coil, Nature of MMF produced in Tr., DC, IM, LIM.

6. Electromotive Force: Expressions of induced emfs developed across a concentrated coil due to relative motion between flux and coil, due to flux pulsation and that due to both relative motion and flux pulsation. The rotation of a concentrated coil in different types of flux density. Special reference to arm reaction emf and leakage reactance emf. Modified expression for emf developed across distributed wing. Nature of the emf developed across the coil in Tr. DC m/c, induction m/c and synchronous m/c. Lump parameter equivalent circuit models for DC m/c, IM and SM, Tr. (Sign conversion). Field energy and derivation of generalized torque equation (sign conversion). Energy flow and efficiency, rating and name plate data.

Part-II: (25 Lectures, 70 Marks)

1. **DC Generators:** Classification on methods of excitation, armature reaction, interpoles and compensating winding, commutation, load characteristic of DC generators, regulation, parallel operation.
2. **DC Motors:** Torque equation, characteristic curves of shunt, series and compound motors, starting starter and grading of starting resistance, speed control – armature voltage control and field control methods. Ward Leonard method, choice of motors for different duties, losses and efficiency, testing- Swinburn's test, back to back test, retardation test and brake test.
3. **Transformer:** Emf equation., relation between voltage per turn and KVA output, phasor diagram based on approx. and exact equivalent circuit, per unit equivalent resistance reactance, open circuit and short circuit tests, back to back test, regulation, losses and efficiency, maximum efficiency, All day efficiency, wall cooling. Two winding and three winding transformers, auto transformer, phase transformer and connections, parallel operation.
4. **Polyphase Induction Motor:** Operation of polyphase induction motors, effect of slots on performance of the motor, equivalent circuit and phasor diagram, locus diagrams, torque and power, speed – torque curve – effect of rotor resistance, deep bar and double cage rotors, performance calculation from circle diagram, methods of speed control, testing, losses and efficiency, application, induction generators and induction regulator.
5. **Linear Induction Motors:** Introduction, operating principles and application areas.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Dr. S.K. Sen	Electrical Machines	Khanna Publishers
2.	P.S. Bimbhra	Electrical Machines	Khanna Publishers
3.	Nagrath& Kothari.	Electrical Machines	TMH

EE 1208 **DIGITAL ELECTRONICS** **L T P C**

4th Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Analog Electronics (EE 1203)

1. **Logic Families and Logic Gates**: TTL, ECL, NMOS, CMOS and PTL logic families and realization of basic logic gates-AND, OR, NOT, NAND, NOR, XOR, XNOR. Transfer characteristics, Inverter ratios, Noise margin, power consumption, propagation delays, fan-in and fan-out.
2. **Number Systems and Codes:** Signed and unsigned numbers and their arithmetic operation, Binary, Hexadecimal, Octal numbers and their conversions. BCD, Excess-3, Gray, 3 out of 5 and Alpha-numeric codes.
3. **Sequential Logic Circuits**: Latches and Flip-flops: RS, JK, D-type Flip-flops, Master-slave flip-flops, Edge triggered FF. Shift Registers- serial and parallel and mixed modes, Counters-Binary, Ripple, Synchronous, asynchronous, Mod-K and decade counters and their design.
4. **Combinational Logics**: Multiplexers, Demultiplexers, Encoder, Decoder, Priority Encoder, parity checkers, half-adders and Full adders. Two-level and Multi-level logics, single and Multi-output functions, logic minimization, K-Map and Queen-Mclauski's Method,
5. **Semiconductor Memories**: ROM, PROM, EPROM, Static and Dynamic RAM, MOS memories, Flash Memory, Memory addressing.
6. **Introduction to ADCs:** flash ADC, dual slope ADC, successive approximation ADC, DAC, R-2R ladder network, weighted resistance DAC, Weighted capacitance DAC.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Malvino and Leech	Digital Principles and Application	McGraw-Hill
2.	M .M. Mano	Digital logic and Computer Design	3rd Edition, Prentice Hall
3.	Alan Markovitz	Introduction to Logic Design	McGraw-Hill
4.	R.P. Jain	Modern Digital Electronics	4th Edition, Tata-McGraw Hill
5.	J.M. Rabaey	Digital Integrated Circuits: A Design Perspective	2nd Edition, Prentice Hall
6.	ZviKohavi	Switching and Finite Automata Theory	Tata-McGraw Hill

EE 1213 **ANALOG & DIGITAL ELECTRONICS LAB** **L T P C**

4th Semester **0 0 2 2**

Electrical Engineering Branch

Prerequisite: Analog Electronics (EE1203) & Digital Electronics (EE1208)

List of Experiments:

1. Study of PIN diagram of ICs and to test the logic gates and verify their truth tables
2. Implementation of half adders, full adders using NAND gates only
3. Implementation of Boolean functions of three or four variables using 74153 (4:1) Multiplexer
4. Addition of two binary numbers using IC 7483
5. To compare two 4-bit binary numbers using magnitude comparator 7485
6. To study the different modes of operation of shift registers using 7495

7. Designing an asynchronous counter of any modulus using JK FF 7473
8. Design of a synchronous counter of any arbitrary count using IC 7473.
9. Different applications of Op-Amps – Adder, Subtractor, Differentiator, Integrator etc.
10. Schmitt's Trigger Circuit
11. Phase Shift Oscillator Circuits
12. Active Filters Design with IC 741

		L	T	P	C
EE 1214	**SOFTWARE ENGINEERING LAB**				
	4th Semester	**0**	**0**	**2**	**2**
	Electrical Engineering Branch				

Prerequisite: Mathematics II, Mathematics III, Analog Electronics (EE 1203) & Digital Electronics (EE 1208)

Verification of Network Theorems using software like MULTISIM, PSIM etc. Solution of linear system algebraic equations using MATLAB or C. Solving numerical solutions of differential equations using MATLAB or C. Simulation of rectifier circuit using normal p-n junction diode using MULTISIM, PSPICE or PSIM software. Simulation of behavior of DC machines using PSIM software.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	C.L Wadhwa	Basic Electrical Engineering	New Age International
2.	P.S. Bimbhra,	Electrical Machines	Khanna Publishers
3.	Hughes	Electrical & Electronic Technology	Pearson

		L	T	P	C
EE-1301	**ELECTRICAL MACHINES -II**				
	5th Semester	**3**	**1**	**0**	**8**
	Electrical Engineering Branch				

Prerequisites: Electrical Machine I (EE 1207)

1. **Synchronous Machines:** General principles, Types of SM and steady state model. Determination parameter. Short circuit ratio, nature of MMF in non-salient-pole m/c and non-salient pole SM, determination of regulation and different characteristics.
2. Introduction to two-reaction theory, slip test, regulation of salient pole m/c, Damper winding & oscillation of synchronous machine, synchronizing power, Determination of transient & sub-transient reactance & time constants of synchronous machine, Determination of sequence impedance, parallel operation.
3. **Synchronous Motors:** Phasor diagram, effect of excitation variation, V-curve, O-curve, power-angle diagram & stability, hunting. Two reaction theory, Methods of starting, Application as phase modifier.
4. **Solid state slip power recovery schemes for induction motor**.
5. **Single Phase Commutator Motors:** Series, repulsion & universal motors – construction, principle of operation starting methods, speed control, power factor, commutation, methods of compensation, Comparison of DC & AC series motors.
6. **Single Phase Induction Motors:** Construction, and analysis, starting & running characteristics, starting methods.
7. **Stepper Motor:** Constructional features, Torque-stepping rate characteristic, Application area.

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	Electrical Machines	Dr, S.K. Sen,	Khanna Publishers
2.	Generalized Theory of Electrical Machines	P.S. Bimbhra,	Khanna Publishers
3.	Electrical Machines	Nagrath& Kothari,	TMH
4.	Theory of A.C. Machines	A.S. Langsdorf.	McGraw Hill
5.	Commutator Machines	Taylor	East West Press

EE 1302 **CONTROL SYSTEM - I** **L T P C**

5th Semester **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Mathematics I, II, III Circuit and Network (EE 1201)

1. **Motivation:** What is control all about, the control problem and solution possibilities, the notion objectives/specifications, feedback as natural strategy, regulation and tracking problems
2. **Models and Physical Systems:** Transfer function: Definition, Examples with mechanical, electrical, hydraulic, pneumatic systems and systems with dead zone; Description of control system components and their representation and transfer functions: Error detectors, Gears, Gyroscope, DC motors, Servomotors, Techo-generators, Servo amplifiers; Block diagram and reduction techniques, Signal flow graphs, Mason's Gain formulae.
3. **Time Domain Analysis:** Transient response analysis (1^{st} and 2^{nd} order): response parameters and their qualitative analysis; Steady state response analysis (1^{st} and 2^{nd} order): response parameters and their qualitative analysis; Transient and steady state response analysis for 1^{st} and 2^{nd} order systems with unity negative feedback structure; Impact of close looping on system parameters and their sensitivity, Error analysis and error constants;
4. **Root Locus Analysis:** Development of root loci, Root motions under close – looping, Pole/zero effects on loci, Effect of rate and reset times, Stability, relative stability and time domain specification using root locus.
5. **Frequency Domain Analysis:** Routh array analysis; Bode plots, Nichols plot, polar plots, Nyquist plot; Stability, relative stability and frequency domain specifications analysis using these plots; Multiple point of view using Bode, Nichols, Polar and Nyquist plots simultaneously; M and N circles.
6. **Controller/ Compensator Design:** Time domain specifications; Frequency domain specifications; Interrelation between TDS and FDS; How to choose a strategy to satisfy a given objective; P, PD, PI, PID error control strategies; Impact on transient response, Impact on S.S. response;
7. **Compensator Design:** Lead, lag and lag – lead compensation, Objectives in Time parameters, Objective in frequency parameters, the role of gains, the role of phase.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	D' Azzo and Houpis	Linear Control Systems Analysis and Design	McGrow Hill
2.	Katsuhiko Ogata	Modern Control Engineering	Pearson Education
3.	M. Gopal	Control Systems Principles and Design	Tata McGrow Hill
4.	N S Nise	Control Systems Engineering	Wiley
5.	Dorf and Bishop	Modern Control Systems	Addison Wesley
6.	Anadanatarajan& Ramesh Babu	Control Systems Engineering	Scitech Publications (India) Pvt Ltd, Chennai

EE-1303	**POWER SYSTEM-II**	**L T P C**
	5th Semester	**3 0 0 6**
	Electrical Engineering Branch	

Prerequisites: Power System I (EE 1205)

1. **Performance of Overhead Transmission Lines:** Introduction; classification of transmission lines; performance calculation of short and medium transmission lines, Nominal T and nominal π methods; Performance Long transmission lines; Power circle diagrams (PCD): Receiving end, sending end, universal PCD, calculation of SPM Capacity, maximum power limit, percentage regulation, sending end power factor, efficiency of transmission line from PCD. Loss and loss diagram.
2. **Power System Stability:** Introduction to synchronous machine, rotor angle, Infinite bus; Definition of stability, classification of stability, power limit of transmission lines, steady state stability, Clarke's diagram, transient stability, the swing equations, equal area criterion, calculation of critical clearing angles, Calculation of power angle curves for fault and post fault conditions for various types of faults, step by step procedure for solution of swing equation, dynamic stability, factors effecting stability
3. **Control of Active and Reactive Power:** Active power and frequency control: fundamental speed governing system, Governor speed regulation parameter, , Fundamentals of automatic generation control, Frequency bias, Primary and secondary control, Basic simulation models of automatic generation control; Reactive power and voltage control: Production of absorber of reactive power, methods of voltage control; shunt reactors, series reactors, synchronous condensers, static VAR system, tap changing transformers.
4. **Economic Operation of Steam Power Plant:** Introduction; Methods of loading turbo - generators, Thermal plant cost modelling, Input - output curves, incremental cost, cost curve: Linear and quadratic, method of Lagrangian multiplier, Equality constraints and inequality constraints, transmission loss, optimum generator allocation with and without transmission loss; Penalty factors, iterative procedure to solve co-ordination equation.
5. **Elements of Hydrothermal Co-ordination:** Advantages of combined operation, plant requirement for base load and peak load operation, Combined working of runoff river plant and steam plant, Reservoir hydro plants and thermal, plant for long term operational aspects, co-ordination equation, scheduling methods, application of scheduling methods.
6. **Transients in Power Systems:** Lightning phenomenon, Switching surges, travelling waves, shape and specifications of travelling waves, attenuation and distortions of travelling waves, alteration due to corona, behaviour of travelling waves at open, short and joints of overhead lines and cables, construction of lattice diagrams.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	C.L. Wadhwa	Electrical Power systems	Wiley Eastern
2.	AshfaqHussain	Electrical Power System	CBS Publishers
3.	B.R.Gupta	Generation of Electrical Energy	S. Chand
4.	Soni, Gupta, Bhatnagar	Electric Power	DhanpatRai& Sons
5.	J.B.Gupta	A course in Power Systems	S.K.KATIA & SONS
6.	P.Kundur	Power system stability and control	McGraw-Hill
7.	O.I.Elgerd	[illegible]: An Introduction	Tata Mcgraw Hill

EE 1304 **MICROPROCESSOR AND MICROCONTROLLER** **L T P C**

5th Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Digital Electronics (EE 1208)

1. **Introduction:** Important features, Educational need, Applications.
2. **Microprocessor architecture:** Arithmetic Logic Unit (ALU), Timing and control Unit, Registers, Data and Address bus, Interface unit, Intel 8085 instructions, Instruction word size: one byte, two byte and three byte instructions, Timing and control signals, Fetch operations, Execution operations, Machine cycle and state, Instruction and data flow, System timing diagram.
3. **Programming microprocessors:** Data representation, Instruction formats, Addressing modes, Instruction set, Assembly language programming, Program looping, Subroutine linkage.
4. **Memory interfacing:** Types of main memories, Compatibility between memory and system bus, Address space, Partitioning of address space, Special chips for address decoding, ROM and RAM interfacing.
5. **Data transfer techniques and their implementation:** Programmed data transfer, DMA mode of transfer, I/O port, Device polling in interrupt driven mode of data transfer, DMA controller and data transfer in DMA mode, Serial mode of data transfer, Introduction to Standard interface chips: 8255, 8259, 8253, 8279.
6. **Microcontrollers**
7. **Common peripherals and their interfacing:** Keyboard, LEDs, Common display and keyboard scanning.
8. **Important features of some advanced microprocessor:** bit microprocessor families: MOTOROLA 68000: The CPU components, Instruction sets, addressing modes etc, Intel 8086/8088: The CPU components, Instruction sets, addressing modes etc; 32 bit microprocessor families: MOTOROLA 68020, Intel 80386, 486, PENTIUM PRO; RISC microprocessors, SUN SPARC, HP precision architecture.
9. **Applications of Microprocessors:** Temperature monitoring and control System, Speed controller of a DC Motor, Data acquisition system.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	John P. Hayes,	Digital Systems and Microprocessors	McGraw-Hill I.E.
2.	R.S.Gaonker	Microprocessor Architecture, Programming and Applications	Wiley Eastern.
3.	D.V.Hall,	Microprocessor and Interfacing: Programming and Hardware	McGraw-Hill I.E
4.	John P. Hayes,	Digital Systems and Microprocessors	McGraw-Hill I.E.

EE 1311 **ELECTRICAL MACHINES LAB-I** **L T P C**

5th Semester **0 0 2 2**

Electrical Engineering Branch

Prerequisites: Electrical Machines-I (EE 1207)

List of Experiments

1. Ratio and polarity test of single phase transformer
2. Parallel operation and load test of single phase transformer
3. Open circuit characteristics of DC Shunt generator
4. Load test of DC Shunt generator
5. Load test of compound generator
6. Speed control of DC shunt motor
7. Speed control of DC series motor
8. Swinburne test of DC machine.

EE 1312 **CONTROL SYSTEM LABORATORY** **L T P C**

5th Semester **0 0 2 2**

Electrical Engineering Branch

Prerequisite:A parallel Course on Control System I (EE 1302)

1. Use of different Toolboxes in MATLAB for simulating transfer functions, closed-loop systems etc. of separately/self-excited DC generators/motors); MATLAB, [transpose, inverse of given matrix.
2. Plot the pole-zero configuration, step response for different values of K, to discuss stability. Plot bode plot, Nyquist plot of given transfer function and gain and phase margins
3. Design of compensators, controllers.
4. To examine the open loop and closed loop frequency response and the effect of addition of poles and zeros
5. Design of observer for plants in observer canonical form using pole placement.
6. Use of LabVIEW.
7. Real time data acquisition and control of processes using ELVIS-II+
8. To study P, PI and PID controller with type 0 and type 1 system with delay.
9. To study Open loop response like (i) Error detector with gain, (ii) Time constant, (iii) Integrator
10. Experiment on relay control system
11. Experiment on AC position control, synchro transmitter/receiver, compensation design, DC Speed control design, DC position control system, potentiometric error detector, Control Engineering Trainer, Modular Servo system, Process Trainer
12. Study of analog electronic PID controller
13. To study Close loop system (I) First order system (II) Second order system (III) Third order system
14. Experiment on relay control system, AC position control, synchro transmitter/receiver, compensation design, DC Speed control design, DC position control system, potentiometric error detector
15. Use of Control Engineering Trainer
16. Use of Modular Servo system
17. Use of Process Trainer

EE 1313	**POWER SYSTEM LABORATORY**	**L T P C**
	5th Semester	**0 0 2 2**
	Electrical Engineering Branch	

Prerequisites: Power System-I (EE 1205), Power System-II (EE 1303)

1. **Generator Control and Synchronizing Circuits:**AutomaticSynchronization in test mode, Synchronization to the actual mains power supply network, Study the response of the programmable controller to incorrect programming**;** Automatic power factor control**:** Synchronizing the generator to the mains power supply network**,** Closed-loop cos-phi control of a synchronous generator**,** Closed-loop cos (phi) control of mains power supply network**;** Automatic power control**:** Synchronizing the generator to the mains power supply network**,** Sensitivity and direction of action of the power controller.
2. **Generator Protection:** Time over current protection, Unbalanced load protection;Reverse power protection, Overvoltage and under voltage protection; Stator-earth fault protection; Generator differential protection.
3. **Transformer:** Multiphase transformer (MPT) operating at no-load and short-circuit; MPT with ohmic, inductive and capacitive load; Parallel operation of MPTs, Current distribution for different vector groups, Determining zero impedance, Investigating the transformation ratio.
4. **Transformer Protection:** Transformer differential protection; Time over current protection;
5. **Transmission line (Power transmission):**Investigations on Three-phase Transmission Lines; Parallel and series connection of transmission lines;Transmission Line with Earth-fault Compensation; Transmission Systems with a Synchronous Generator.
6. **Transmission Line Protection:**Over current time protection for lines, Directional over current time protection for lines, Overvoltage and under voltage protection, Directional power protection; Earth-fault voltage protection; Protection of Parallel-connected Lines, High-speed distance protection.
7. **Electric Power Distribution (Three-phase double bus bar system):**Electric power distribution (Three-phase double busbar system) - Basic circuits of a three-pole, double busbar system, Three-phase, double bus bar system with load, Busbar changeover without interruption of the branch, busbar coupling.
8. **Over Current Protection for Busbar:**Registration of currents in normal operating mode, Registration of currents in the event of single-, double- or triple-pole short circuit, Faults outside the protective domain.

EE 1305	**CONTROL SYSTEM-II**	**L T P C**
	6th Semester	**3 1 0 8**
	Electrical Engineering Branch	

Prerequisites: Control System I(EE 1302)

1. **Introduction to Digital Control:** Z Transform, Signal processing in digital control, Principles of signal conversion, Transfer function models for discrete time systems, System response, Stability in the z – plane and the jury stability criterion, Sampling and data reconstruction process, Z – domain description of closed loop systems, Systems with dead – time, Implementation of digital controllers; Digital Controllers for deadbeat performance.
2. **State Space Representation of Continuous Time and Discrete time systems:** Introduction to state space model, State Space equations in Canonical forms, Modeling of few electrical and mechanical systems in State Space form, Solution of time invariant, time variant continuous time systems & discrete time system state equations, Concept of state transition matrix, Controllability and Observability, Relation between transfer function and state variable representations, Pole-placement using state variable feedback, Design of full order state observers, reduced order observer, observer based state feedback controller.
3. **Introduction to Nonlinear Feedback Control Systems:** Characteristics of Nonlinear systems, Linearization technique; Phase Plane analysis, Singular points, Limit cycle vs closed trajectory, Stability analysis using Phase Plane analysis; Describing function of common nonlinear functions, stability analysis using DF;

Stability in the sense of Liapunov, Liapunov's stability theorems for linear and nonlinear systems; Effect of Non-linearity in Root Locus and Nyquist Plot.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Dorf and Bishop	Modern Control Systems	PHI
2.	Ogata	Modern Control Engineering	PHI
3.	B.C.Kuo	Digital Control System	PHI
4.	M. Gopal	Modern Control System theory	PHI
5.	Donald M Wiberg	State Space and Linear Systems	Schuam's Outline Series

EE-1306 **POWER ELECTRONICS** **L T P C**

6th Semester **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Analog Electronics (EE 1203)

1. **Introduction:** Concept of Power Electronics, Different types of power electronics devices, converter systems, areas of application, recent developments
2. **Device Characteristics, Protection and Operation:** Terminal characteristics of major power electronics devices, ratings, protection, heating, cooling and mounting, series and parallel operation, firing circuits
3. **Phase Controlled Rectifiers:** Principles of operation of phase controlled, single phase & poly-phase, full-wave & half-wave converters with continuous and discontinuous load currents and harmonic analysis. Effect of source impedance on the performance of converters, dual converters
4. **Choppers:** Principle of chopper operation, Control strategies, Types of chopper circuits and steady state analysis. Commutation in chopper circuits, Multiphase chopper.
5. **Inverters:** Classification of inverters, Single-phase and three-phase Voltage source Inverters, Methods of controlling output voltage, frequency and phase, Reduction of harmonics in the inverter output voltage, Current source inverters and operations.
6. **AC Voltage Controller:** Types of AC voltage controllers, Single phase voltage controllers, Sequence control of ac voltage controllers, 3-phase AC voltage controller operation
7. **Cycloconverters:** Principles of cycloconverter operation, Methods of controlling output voltage and frequency in cases of: Single phase to single phase, three phase to single phase, three phase to three phase operation.
8. **Applications:** Power supply applications, few applications in residential and industrial systems, Electric utility.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	P C Sen	Power Electronics	TMH
2.	Dubey	Power Electronics	TMH
3.	Dubey*et. al.*	Thyristorised Power Controllers	New Age
4.	Rashid Mohammed	Power Electronics	PHI
5.	V. Subrahmanyam	Power Electronics & Drives	New Age
6.	P.S.Bhimbhra	Power Electronics	Khanna Publishers
7.	Singh &Khanchandani	Power Electronics	TMH

EE 1307 **SWITCHGEAR AND INDUSTRIAL PROTECTION** **L T P C**

6th Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power system II (EE 1303)

1. **Symmetrical Fault Analysis:** Causes of faults, types of faults, importance of fault analysis in electrical power systems, fault analysis for generators, transmission lines, concepts of generator reactance's; transient, sub-transients etc, current limiting reactors, types, functions.
2. **Symmetrical Components and Unsymmetrical Fault Analysis:** Concepts of symmetrical components, fortescue's theorem, power in terms of symmetrical components, sequence impedances and sequence networks for generators, transformers, transmission lines etc, unsymmetrical fault (L-G, L-L, LL-G) analysis.
3. **Neutral Grounding:** Fundamentals of neutral grounding, ungrounded system analysis, arcing ground, solid grounding, types of grounding, resistance, reactance and resonant grounding, generator neutral breaker, grounding practice.
4. **Circuit Breakers:** Function, importance, arc phenomenon, arc interruption theories, CB types and description, Circuit breaking transients, restriking and recovery voltages, CB ratings, testing of CB's.
5. **Protective Relays:** Operating principle, classification, Electromagnetic type relays theories for torque generation, concepts of protective zones, Over Current relay characteristics, Directional relay torque generation, feeder protection, time grading & current grading, Distance protection philosophies, Distance relays and their characteristics, differential protections, Protection of Transmission lines, generator and transformers, Transley relay, negative sequence relay, Fuses.
6. **Sub-Stations:** Function of sub-station, necessity, types and arrangement of sub-station equipments, single line diagram with different busbar arrangement including reactors, bus-tie breakers, substation grounding, surge protection,
7. **Lightning Arrester:** Function, types, working principles and surge absorbers.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	C. L. Wadhwa	Electric Power systems	New Age International
2.	Willium D. Stevenson Jr.	Elements of Power System Analysis	John Wiley & Sons
3.	D P Kothari, I J Nagrath	Modern Power System Analysis	TMH Publishing Co.
4.	J B Gupta	Switchgear and Protection	S.K. Kataria& Sons
5.	Sunil S Rao	Switchgear and Protection	Khanna Publisher
6.	B. Ravindranath and M. Chander	Power System Protection and Switchgear	Wiley Publisher
7.	AshfaqHussain	Power Systems	CBS Publishers

EE 1308 **PROGRAMMING AND DATA STRUCTURE** **L T P C**

6th Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

1. **Introduction to Programming:** variables, assignments; expressions; input/output; conditionals and branching; iteration; functions; introduction to pointers;

2. **Linear Data Structures:** Sequential representations - Arrays and Lists, Stacks, Queues and Dequeues, strings, Application. Linear Data Structures - Link Representation - Linear linked lists, Circularly linked lists. Doubly linked lists, application.
3. **Recursion:** Design of recursive algorithms, Tail Recursion, When not to use recursion, Removal of recursion.
4. **Non-linear Data Structure :** Trees - Binary Trees, Traversals and Threads, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and weight-balanced trees, B-trees, B+ -trees, Application of trees; Graphs - Representations, Breadth-first and Depth-first Search.
5. **Hashing -** Hashing Functions, collision Resolution Techniques.
6. **Sorting and Searching Algorithms** - Bubble sort, Selection Sort, Insertion Sort, Quicksort, Merge Sort, Heapsort and Radix Sort.
7. **File Structures:** Sequential and Direct Access. Relative Files, Indexed Files - B+ tree as index. Multi-indexed Files, Inverted Files, Hashed Files.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	O.G.Kadke and U.A.Deshpandey	Data Structures and Algorithms	ISTE/EXCEL
2.	Aho Alfred V., Hopperoft John E., UIlman Jeffrey D.	Data Structures and Algorithms	PearsonEducation
3.	Ajoy Agarwal	Data Structures	C.Cybertech.
4.	Lipschutz	Data Structures	TMH
5.	Heileman	Data structures, Algorithims& OOP	Tata McGraw Hill
6.	M.Radhakrishnan and V.Srinivasan	Data Structures Using C,	ISTE/EXCEL BOOKS
7.	Weiss Mark Allen	Algorithms, Data Structures and Problem Solving with C++",	Pearson Education.
8.	Horowitz Ellis &SartajSahni	Fundamentals of Data Structures	Galgotria Pub.
9.	Tanenbaum A. S.	Data Structures using 'C'	Pearson Education

EE 1309 **INSTRUMENTATION** **L T P C**

6th Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Analog Electronics (EE 1203), Control System –I(EE 1302)

1. **Introduction:** Generalized performance & functional description of an Instrumentation system, Role of Transducers, Amplifiers, Filters, Display devices etc. Review of idea on DA/ADC, filters & signal conditioners, OP-AMPS, Instrumentation amplifiers & its circuits.
2. **Analytical Instrumentation:** Measurement of pressure, Measurement of flow (EM flow meter), Measurement of temperature, Measurement of liquid level etc.
3. **Transducers & Sensors:** Introduction, definition, classification & selection of transducers/ sensors; Resistive, capacitive, inductive (LVDT), piezoelectric transducers & their applications; Thermistors: measurement of temperature; Magnetostrictive, Hall Effect, electromagnetic transducers; photoelectric transducers.

4. **Nondestructive Testing Equipments:** Introduction, Magnetic particles, Dye penetrants, X rays, Gamma rays; Eddy current testing; Ultrasonic- principle of working. Pulse echo method of flaw detection.

5. **Data Transmission & Telemetry:** Definition, classification, basic telemetering system.

   a) Voltage, current & frequency telemetering systems.

   b) Multiplexing & modulation in telemetry

   c) PLCC

   d) Transmitters-techniques & inter stage coupling. Receivers- techniques.

6. **Fiber optical instrumentation:**

   a) Introduction, principle of working

   b) Optical fiber cable, Dispersion & losses

   c) Connectors& splices, sources & detectors.

   d) Transmitters & receiver circuits.

   e) Applications

7. **Related topics:**

   (a) Digital data acquisition systems

   (b) Smart sensors – Introduction, Principle of working, information coding, data communication & automation.

   (c) Intelligent Instrumentation- definition, practical examples.

   (d) Remote control: Introduction, general descriptions, typical scheme of an industrial remote control system.

   (e) Internet based tele-metering.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	D. Patranabis	Principles of Industrial Instrumentation	Tata McGraw Hill
2.	D. Patranabis	Sensors & Transducers	PHI
3.	Rangan, Sharma & Mani	Instrumentation, Devices & system	Tata McGraw Hill
4.	D.V.S Murthy	Transducers & Instrumentation	PHI

EE 1314 **ELECTRICAL MACHINE LAB-II** **L T P C**

6th Semester **0 0 2 2**

Electrical Engineering Branch

Prerequisites: Electrical Machine-I (EE 1207), Electrical Machine-II (EE 1301)

1. Speed control of DC Series motor.
2. No load and block rotor operation of 1-phase Induction motor.
3. Open ckt and S.C characteristics of 3-phase alternator.
4. Determination of $X_d$and X_q of a three phase alternator by slip test.
5. V-Curve of Synchronous motor.
6. Three phase to six phase connection.
7. Load characteristics of D.C. Series motor.
8. Load characteristics of D.C. compound generator
9. Parallel operation of 3-phase alternator

EE 1315 PROCESS CONTROL AND INSTRUMENTATION LABORATORY L T P C

6th Semester 0 0 2 2

Electrical Engineering Branch

Prerequisite: Control System –I (EE 1302)

List of Experiments in the Process Control Laboratory

1. Use of Technology Tutor:
    a. Wheatstone bridge: measurement of resistance, conditions for the greatest sensitivity, operation with alternating current source. Operation with amplifier, transducer.
    b. Characteristics of various types of transducers, their calibration.
    c. Assembling a complete measuring system and derive a voltage/position calibration curve for.
    d. To design, setup a continuous control system and observe its dynamic characteristics.
2. Use of various sensors (temperature, level, liquid flow, air flow, pressure Gauge) in loops comprising PID controller, PLC & DCS and their modeling.
3. Real time measurement and control of simple systems using LabVIEW
4. Study of sensors characteristics using LabVIEW
5. Control with PCs of the above five (Sl-2) process loops in LabVIEW platform
6. Measurement of flow, level using different sensors for different pipe diameters and liquid temperatures
7. Comparative study of temperature measurement using: RTD and Thermistor, RTD and Thermocouple.
8. Simulation and control of process control plants.
9. Use of PLC (in design, reversing contact, conveyor belt, street light & garage door automation, etc.)

EE 1316 MICROPROCESSOR AND MICROCONTROLLER LABORATORY L T P C

6th Semester 0 0 2 2

Electrical Engineering Branch

Prerequisite: Microprocessor and Microcontroller (EE 1304)

1. Write a Program to add two hexadecimal numbers.

2. Write a Program to subtract two hexadecimal numbers.

3. Write a Program to find the product of two hexadecimal numbers each of length 4 bits.

4. Write a Program to perform division of two hexadecimal numbers.

5. Write a Program to arrange a list of unsigned integers in ascending order.

6. Write a Program to arrange a list of unsigned integers in descending orders.

7. Write a Program to design a digital clock using only a single microcomputer.

8. Write a Program to design a digital clock using only a single microcomputer.

9. Write a Program to design and implementation of design clock in hardware using 8085 and its peripherals.

10. Write a Program to driving of Stepper Motor using 8085

EE 1401 **DIGITAL SIGNAL PROCESSING** **L T P C**
7th Semester **3 0 0 6**
Electrical Engineering

Prerequisites: Signals and Systems (EE 1206)

1. **Discrete-Time Signals & Systems:** Advantages of digital over analog signal processing, discrete-time signals and sequences, representation of sequences and elementary operations, classification of discrete-time systems. Resolution of discrete-time signals into impulses, analysis of discrete-time LTI systems. Response to arbitrary inputs, the convolution sum, properties of LTI systems and their interconnections, causality, stability. Linear constant coefficient difference equation and their solutions. Impulse response of LTI system, response to complex exponential and sinusoidal signals, the frequency response function.
2. **Transforms:** Representation of sequences by Fourier transforms-symmetry properties and theorems. The Z-transform, two-sided and one-sided z-transforms, ROC, properties of z-transform, Inverse z-transform, Analysis of LTI system in the Z-domain.
3. **Sampling:** Sampling of continuous time signals, periodic sampling, frequency-domain representation of sampling.
4. **Transform Analysis of LTI System:** System functions-linear constant coefficient difference equations, poles and zeros, rational system function, causality and stability, frequency response of LTI systems, phase distortion and delay, frequency response for rational system functions and for single pole or zero systems.
5. **Structures for Discrete-time Systems:** Block diagram representation of linear constant coefficient difference equations and their interconnections. Direct form I, direct form II, cascade form and parallel form structures, Finite precision word-length effect-number representation, analysis of effect of coefficient quantization and rounding off of noise, zero input limit cycles in fixed point realization of IIR digital filters.
6. **Filter Design Techniques:** Characteristics of practical frequency selective filters, design of FIR filters by windowing. Characteristics of Butterworth &Chebyshev filters, design of IIR filters from continuous time filters- impulse invariance and bilinear transformation methods.
7. **Discrete Fourier Transforms:** Frequency domain sampling, the DFT and properties of DFT, circular convolution, linear convolution using DFT, Application of DFT for A.C. transient analysis
8. **Efficient Computation of DFT:** Computational complexity, FFT algorithms- the decimation-in-time and decimation-in-frequency; signal flow graph-Butterfly computations, in-place computations, analysis of computational complexities.
9. **Multi-rate signal processing** and introduction to Wavelets.
10. **VLSI implementation** of digital filters and signal processing algorithms, implementation of signal processing algorithms in general purpose processor, specialized DSP processors.
11. **Applications of Signal Processing:** Spectral analysis using DFT, musical sound and audio processing, **application of signal processing in power system, fault detection and improving power quality, MATLAB programming.**

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Oppenhein and Schaffer	Discrete-time Signal Processing	PHI
2.	Proakis&Manolakis	Digital Signal Processing	PHI
3.	Chen C.T.	Digital Signal Processing: Spectral Computation& Filter Design	Oxford Univ. Press
4.	Sanjit K. Mitra	Digital Signal Processing	TMH

EE 1402	INDUSTRIAL DRIVES	L	T	P	C
	7th Semester	3	0	0	6

Electrical Engineering Branch

Prerequisites: Power Electronics (EE 1306)

Part – I

1. **Introduction:** Concept of Electrical Drive, Advantages over other drives, Different parts, Classification, choice of Electrical Drives, Status of dc and ac Drives.
2. **Dynamics of Electrical Drives:** Fundamental torque equation, Speed Torque conventions and multi-quadrant operation, Nature and classification of load torques, Dynamics of motor-load combination and equivalent drive system, steady state stability & transient stability of electric Drive.
3. **Selection of Motor Power Rating:** Thermal model of motor for heating and cooling, loading conditions and classes of motor duty, Determination of power rating of electric motors for different applications, effect of load inertia, load equalization, environmental factors.
4. **Starting:** Effect of starting on power supply, motor and load, determination of acceleration time, energy relations during starting, methods to reduce the energy loss during starting.
5. **Electric Braking:** Types of electric braking and advantages, braking of dc motors induction motors during lowering of loads and while stopping, braking of synchronous motors, energy relations during braking.

Part- II

6. **Control of Electrical Drives:** Modes of operation, speed control and drive classifications, closed-loop control of drives: current-limit control, torque control, speed control, speed control of multi-motor drives, Speed sensing, current sensing, phase-locked-loop (PLL) control, closed-loop position control (Methods employed and description of different schemes only).
7. **Control of DC Drives:** Speed control of dc separately excited motor using: (a) single-phase and three-phase controlled rectifiers (b) Dual-converter and (c) Chopper, Steady state and transient analysis
8. **Control of Induction Motor Drives:** Control of IM using variable frequency operation based on VSI, CSI &Cycloconverter, Speed control of wound rotor Induction Motor by (a) Static rotor resistance control (b) Static Scherbius drive (c) Static Kramer drive.
9. **Industrial Applications:** Drives for steel Mills, Paper Mills, and Textile Mills.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	S.K. Pillai	A first course on Electrical Drives	Willey Eastern Ltd.
2.	G.K. Dubey	Fundamentals of Electrical Drives	Narosa
3.	V. Subrahmanyam	Electric Drives	New Age
4.	Bimal K Bose	Electric Drives	Oxford(OUP)

EE 1411	POWER ELECTRONICS AND DRIVES LAB	L	T	P	C
	7th Semester	0	0	2	2

Electrical Engineering Branch

Prerequisite: Power Electronics (EE 1306), Industrial Drives (EE 1402)

List of Experiments:

1. To study of terminal characteristics of SCR, TRIAC, MOSFET, IGBT

2. To study the operational features of triggering circuits: resistance gate triggering circuit for SCR; resistance-capacitance gate triggering circuit for SCR; UJT triggering circuit for SCR
3. To study the operation single-phase controlled rectifiers: half-wave controlled, fully-controlled and half-controlled (semi-converter)
4. To study the functional controlled operation of class-A type voltage commutated DC chopper
5. To study the functional operation of single-phase AC voltage-controller (i) using anti-parallel SCRs, (ii) TRIAC
6. To study the functional operation of single-phase Cycloconverter with R and RL load
7. 1-Ph Thyristor bridge based fully Controlled Converter Fed DC Motor Drive using Analog Mode open/ closed loop speed controller
8. 3-Ph Thyristor bridge based fully Controlled Converter Fed DC Motor Drive using Analog Mode open/ closed loop speed controller
9. 1-Ph IGBT based Four Quadrant Chopper Fed PMDC Motor Drive using Analog Mode open/ closed loop speed controller
10. To study the open/closed loop V/F control of 3-Ph, Induction Motor using 3-Ph IGBT based Inverter and TMS320LF2407A DSP controller

EE 1403 **ANALOG & DIGITAL COMMUNICATIONS** **L T P C**

8th Semester **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Signal and System (EE 1206)

1. **Introduction:** The history of evolution of Electrical Communication, Concept of information, messages and signals, Knowledge of Signals and Information representation, Elements of a communication system, Communication channels, Base band and pass band signals, Fundamental limitations.
2. **Representation of signals and systems:** Fourier transform, Properties of the Fourier transform, Parseval's theorem, Rayleig's energy theorem, Dirac-Delta function, Fourier transform of Periodic linear systems. Representation of energy and power signals and their spectral density; External noise, internal noise, Noise calculations, signal to noise ratio.
3. **Continuous Wave modulation:** Amplitude modulation and spectra, DSB Signals and spectra, Tone modulation and phasor analysis, Switching modulator, Envelope detector, Ring modulator and balanced modulator, Single side band modulation, Phase Shift method for generation of SSB, Phase and frequency modulation, Narrowband F.M, Wideband F.M, Transmission B.W. of F.M. signal, Generation of F.M. signal. Indirect F.M. & Direct F.M, Demodulation of F.M. signal using balanced frequency discrimination. AM transmitters and receivers, super heterodyne receiver, IF amplifiers, AGC circuits.
4. **Random Variables and Stochastic Process:** Concept of random variables, Probability density function and probability distribution function of α random variable, Mean & Mean square value of a R.V, Concept of Stochastic Process, Ensemble averages and correlation function, Stationary and Ergodic Process, Signal Power, Time average and Power spectral density, Shot noise, Thermal noise and White noise.
5. **Sampling and Pulse modulation:** Sampling Process, Sampling Theorem (only statement), Analogy Pulse modulation : PAM, PPM and PDM, Time Division Multiplexing, Quantization Process (only uniform quantization), Quantization noise, Pulse code modulation, Delta modulation, Differential Pulse Code modulation.
6. **Digital Communication:** Base band Pulse Transmission concept., Method filter, Pass band transmission model, Gram Schmidt Orthogonalization principle, Geometrical interpretation of signal, Digital modulation techniques, Coherent binary PSK, Coherent binary FSK, Coherent quadriphase shift keying.

7. **Introduction to Information Theory:** Uncertainty, Information and Entropy, Properties of Entropy, Source coding theorem. Measure of information, Entropy & Information rate, channel capacity, Hartley Shannon law, Huffman coding, Shannon Fano coding.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Bruce Carlson	Communication Systems	McGraw Hill I.E.
2.	Taub and Schilling	Principles of Communication Systems	McGraw Hill I.E.
3.	Simon Hymins	Communication Systems	PHI
4.	BP Lathi	Modern Digital and Analog	Oxford university Press
5.	Couch	Digital and Analog Communication	Pearson Education India
6.	John Proakis	Digital Communications	McGraw Hill

EE 1421 **HIGH VOLTAGE AC/DC** **L T P C**

Departmental Elective I **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303)

1. **Breakdown Mechanism of Gases, Liquid and Solid Materials:** Properties of Gas as an insulating medium and their breakdown, Townsend's current growth equation and criterion for breakdown, Electronegative gases-their properties and breakdown, Streamer theory of breakdown in gases, Paschen's law, Conduction and breakdown of liquid dielectric, Pure & commercial liquids - origin, purification and breakdown, Transformer oil - composition, purification, testing and breakdown, Different types of breakdown in solid dielectric, Breakdown in composite dielectric, Measurement of intrinsic strength, partial discharge, Different types of solid dielectric - use, property and breakdown.
2. **Electrical Properties of High Vacuum:** High vacuum as a dielectric, Pre-breakdown condition, Factors effecting the breakdown voltage and breakdown phenomenon,
3. **Over Voltage Phenomenon & Insulation Co-ordination:** Natural cases of over-voltage,-lighting over-voltage, Traveling waves on Transmission line, Over voltage due to arching ground, Line design based on lighting, Insulation co-ordination & over voltage protection, Magnetic surge crest ammeter, Klydonograph, Fulcharnograph, Oscillograph, surge absorber, ground and counter-poise wires, lightning arrestors etc.
4. **High Voltage Generation:** Generation of high voltage DC – voltage multiplier circuit, Generation of A.C. high voltage – cascade transformers & resonant transformers, Generation of Impulse voltage – Multistage Impulse generator method (Marx Circuit),Generation of Impulse current, Van-de-graph generator.
5. **Measurement of High Voltage & Currents:** Measurement of high D.C. voltage- Generating voltmeter, Measurement of A.C. voltage- Electrostatic voltmeter, sphere gaps, Measurement of A.C. high frequency Impulse voltage- peak voltmeters, sphere gaps, Measurement of DC current – Hall generator, Measurement of AC current- current transformer, Measurement of Impulse currents- CRO.
6. **High Voltage Equipments:** Bushing - classification, construction & application breakdown of Design, Guard Ring and shields, High voltage Bus-bar-Introduction, High voltage cables – Introduction.
7. **High Voltage Testing and Testing Techniques:** Testing of overhead line insulator, Testing of cable, Testing of Bushing, Testing of power transformer, Testing of circuit breakers and Isolators, Measurement of Resistivity, Dielectric constant and loss factor, High voltage Schering bridge, Testing of surge Arrestors.
8. **Design, Planning and Layout of High Voltage Laboratory:** Testing facility, activities of a H.V. Laboratory, Planning, clearance and layouts, Test equipment and layout, Safety measures, Grounding techniques of H.V. Impulse laboratory.

9. **Introduction to EHV. System & EHV Lines:** Effect of corona on EHV line, Lightning and lightning protection

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	M.S. Naidu and V. Kamaraju,	High voltage Engineering	Tata McGraw Hill, 2nd Edition
2.	C.L. Wadhwa,	High voltage Engineering	New Age.
3.	M. Khalifa,	H. V. Engineering- Theory and Practice	Marcel Dekker Inc.
4.	Rakesh Das Begamudre,	Extra High Voltage A.C. Transmission Engg	New Age
5.	Prof. D.V. Razevig,	High Voltage Engineering	Khanna Publishers.
6.	Sunil S. Rao,	Switchgear and Protection	Khanna Publishers.

EE 1422 **POWER ELECTRONICS IN POWER SYSTEMS** **L T P C**

Departmental Elective I **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303), Power Electronics (EE 1306)

1. General aspects of DC transmission, converter circuits and their analysis, DC link controls, faults and abnormal operation and protection, Steady state and dynamic problems in AC systems. Flexible AC transmission systems (FACTS).
2. Principles of series and shunt compensation. Description of static var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC), Interline Power Flow Controller (IPFC), circuit, steady-state behaviour and control, advantage over UPFC. Modelling and Analysis of FACTS controllers. Control strategies to improve system stability.
3. Power Quality problems in distribution systems, harmonics, harmonics creating loads, modelling, harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters, voltage sags & swells, voltage flicker. Mitigation of power quality problems using power electronic conditioners. IEEE standards

Reference Books:

S.N.	Name of the Books	Author	Publisher
1.	Power Quality	G.T. Heydt	Stars in a Circle Publications, Indiana, 1991.
2.	Static Reactive Power Compensation	T.J.E. Miller	John Wiley & Sons, New York, 1982.
3.	Reactive power control in Electrical system	T. J. E. Miller	John Wiley & Sons, New York, 1982.
4.	FACTS CONTROLLERS in Power Transmission & Distribution	K. R. Padiyar	New Age International (P) Ltd.," 2007.
5.	HVDC POWER TRANSMISSION SYSTEMS Technology and System Interactions	K. R. Padiyar	New Age International (P) Ltd.," 1990.
6.	Understanding FACTS Concepts & Technology of FACTS Systems	Hingorani N. G	IEEE PRESS, 2000
7.	Power Electronic Converter Harmonics	Derek A. P.	IEEE Press. 1989
8.	Power System Harmonic Analysis	Arrillaga J., Smith B. C., Watson N. R. and Wood A. R.	Wiley India.2008

9.	Power System Analysis	Arthur R. B.,	Pearson Education. 2008
10	Power System Harmonics	Arrillaga J., Braedlley D. A. and Bodger P. S.	John Wiley and Sons.1985
11	Electrical Power System Quality	Dugan R. C., McGranaghan M. F. and Beaty H. W.	McGraw-Hill International Book Company. 1996
12	Power Quality	Sankaran C.	CRC Press
13	Power Electronic Control in Electrical Systems	E Acha, V.G. Agelidis, O Anaya-Lara, T J E Miller	Elsevier
14	Recent publications on Power Systems and Power Delivery	--	--

EE 1423 **HIGH POWER SEMICONDUCTOR DEVICES** **L T P C**

Departmental Elective I **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power Electronics (EE 1306), Analog Electronics (EE 1203)

1. **Power Semiconductor Devices:** PNPN diodes, DIACS, Thyristors, TRIACS, GTO devices. Power transistors, Power MOSFET. Rating, Losses and Cooling. Triggering circuits for SCRs, UJT. Blocking Oscillators, Schmitt trigger circuits – Power MOS gate drive circuits.Uncontrolled and controlled Rectifiers: Single phase and polyphase Bridge rectifiers. Transformer ratings. Inductive load, free wheeling diodes.
2. **Converter Operation:** Overlap, power factor, inversion, regulation, P-pulse converters, power factor control via PWM converters.
3. **D.C. Line Commutation:** Series and parallel capacitor turn off, resonant turn off, impulse commutation. AC Voltage Controllers / Regulators. D.C. Choppers: Principles, classification, use.
4. **Frequency Conversion:** Cycloconverter - single and three phase circuits, blocked Group operation, circulating current mode. Single phase and three phase inverters, constant voltage source and constant current source inverters, HF inverters for heating. Application: D.C. and A.C. drives, SMPS, Resonant converters, AC Line Filters, ratio, interference suppression. HDVC transmission.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Lauder C W	Power Electronics	MHI, 3rd Edn
2.	Sen P C	Power Electronics	TMH
3.	Rashid M H	Power Electronics	PHI Pub
4.	Dubey S K	Thysistorised Power Controller	John Wiley & Sons
5.	Singh M D &Khanchandni	Power Electronics	TMH Pub
6.	Mohan N, Underland T M & Robbins W P	Power Electronics	John Wiley & Sons
7.	Bose B K	Modern Power Electronics	Jaico Pub. House
8.	Dubey G.K	Thyristorised Power Controllers	New Age International
9.	Subramanyam	Power Electronics	New Age International
10.	Sugandhi	Thyristors: Theory & Applications	New Age International

EE 1424 **DIGITAL CONTROL SYSTEMS** **L T P C**

Departmental Elective I **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Control System I(EE 1302) and Control System II(EE 1305)

Introduction to Digital Control: Introduction, Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction

Modeling Discrete-Time Systems by Pulse Transfer Function: Revisiting Z-transform, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system, Sampled signal flow graph

Stability Analysis of Discrete Time Systems: Jury stability test, Stability analysis using bi-linear transformation

Design of Sampled Data Control Systems: Root locus method, Controller design using root locus, Root locus based controller design using MATLAB, Nyquist stability criteria, Bode plot, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain

Discrete State Space Model: Introduction to state variable model, Various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation

Controllability, Observability and Stability of Discrete State Space Models: Controllability and Observability, Stability, Lyapunov stability theorem

State Feedback Design for Discrete Systems: Pole placement by state feedback, Set point tracking controller, Full order observer, Reduced order observer

Output Feedback Design for Discrete Systems: Output feedback design: Theory, Output feedback design: Examples

Introduction to Optimal Control for Discrete Systems: Basics of optimal control, Performance indices, Linear Quadratic Regulator (LQR) design.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Gopal, M.	Digital Control and State Variable Methods	THM
2.	B. C. Kuo	Digital Control Systems	Oxford University Press, 2/e, Indian Edition, 2007
3.	K. Ogata	Discrete Time Control Systems	Prentice Hall, 2/e, 1995
4.	G. F. Franklin, J. D. Powell and M. L. Workman.	Digital Control of Dynamic Systems	--

EE 1425	ELECTRICAL ENGINEERING MATERIALS	L	T	P	C
	Departmental Elective I	**3**	**0**	**0**	**6**
	Electrical Engineering Branch				

Prerequisites: Basic Electrical Engineering (EE 1101)

1. **Dielectrics**: Dielectric properties of insulators in static fields. The static dielecric constant. Polarization and dielectric constant. Dielectric constant of monatomic gases and polyatomic molecules. Internal fields in solids and liquids. Ferroelectric materials, spontaneous polarization, piezoelectricity
2. **Behaviour of Dielectrics in Alternating Fields:** Frequency dependence of the electronic polarizability. Ionic polarization as a function of frequency. Complex dielectric constant of non-dipolar solids. Dipolar relaxation. Dielectric losses. Dielectric gases. Liquid insulating materials. Solid insulating materials. Films.
3. **Magnetic Properties of Materials**: Magnetic dipole moment of current loop. Magnetisation from a macroscopic viewpoint. Orbital magnetic dipole moment and angular momentum of two simple atomic models. Lenz's law and induced dipole moments. Classification of magnetic materials. Diamagnetism. Origin of permanent magnetic dipole moments. Paramagnetism, ferromagnetic domains, magnetic anisotropy. Magnetostriction, antiferromagnetism, ferromagnetism, magnetic materials for electrical devices.
4. **Conductors**: Free electron theory of metals, Ohm's law, relaxation time, collision time and mean free path. Electron scattering and the resistivity of metals. Heating effect of current, thermal superconductivity.
5. **Properties of Semiconductors**: Electron-hole concentration, Fermi level, Generation and recombination, carrier life-time, diffusion length. Scattering and mobility of carriers. Einstein relation. LASER.

6. **Conducting Materials**: High conductive materials-copper, Aluminum, Tungsten, Nickel, Brass, Bronze and other alloys; contact materials-Mercury, other alloys; High resistivity materials-carbon, graphite, Nichrome; Fuses.

7. **Insulating Materials**: Gaseous materials-Oxide gases, electronegative gases, hydrocarbon gases; Liquid materials-mineral oils, silicon liquids, hydrocarbon liquids; Solid materials-Paper and boards, Resins (Polymers), Rubbers-natural and synthetic, glass, ceramics, asbestos.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	S.P. Seth, P.V. Gupta	A course in Electrical Engineering Materials	DhanpatRai& Sons
2.	A.J. Dekker	Electrical Engineering Materials	PHI.
3.	Ian P. Jones	Materials Science for Electrical & Electronics Engineers	Oxford
4.	L. Solymar& D. Walsh	Electrical Properties of Materials	Oxford
5.	J.K. Shackelford & M.K. Muralidhara	Introduction to material science for engineers	Pearson Education

EE 1426 **SMART GRID** **L T P C**

Departmental Elective I **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303)

1. **Basic Power Systems:** Load Modeling and generation systems for conventional and restructured power system. Power Flow Analysis.

2. **Renewable Generation**: Renewable Resources: Wind and Solar, Micro-grid Architecture, Distributed Storage and Reserves, Dealing with short term variations, stochastic models based on price forecasting.

3. **Power System Economics:** Power system generation economics, Modeling of Consumers and producers, Electricity market structures, Marginal price, Optimal Power Flows, Distribution systems basics under new environment etc.

4. **Smart Grid:** Definition, Various components, Application and standards, Impacts of Smart Grid on reliability, Impacts of Smart Grid on air pollutant emissions reduction.

5. **Smart Grid Communications:** Two-way Digital Communications Paradigm, Network Architectures, IP-based Systems Power Line Communications, Advanced Metering Infrastructure.

6. **Demand Side Management:** Definition, Applications, Load characteristics, load curve and load duration curve, Energy Consumption Scheduling, Controllable Load Models, Dynamics, and Challenges, Plug-in-hybrid Vehicles and smart appliances.

7. **Wide Area Measurement:** Sensor Networks, Phasor Measurement Units, Communications Infrastructure, Fault Detection and Self-Healing Systems, Applications and Challenges.

8. **Security and Privacy:** Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defense Mechanisms, Privacy Challenges.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	D.S. Kirshen	Fundamentals of Power System Economics	John Wiley & Sons
2.	A. J. Wood, B. F. Wollenberg	Power Generation Operation and Control	John Wiley & Sons
3.	G. M. Masters	Renewable and Efficient Electric Power Systems	John Wiley & Sons
4.	S. Stoft	Power System Economics: Designing Markets for Electricity	Wiley-Interscience
5.	A.Mazer	Electric Power Planning for Regulated and Deregulated Markets	John Wiley & Sons

EE 1427	INDUSTRIAL MANAGEMENT Departmental Elective I Electrical Engineering Branch	L T P C 3 0 0 6

Prerequisites: Managerial Economics (HS 1201)

1. **Industrial Engineering:** Concept and evolution of I. E. theory and practice. Its role and application, time and motion study techniques, workplace layout, stop watch time study, worksampling, therbligs.
2. **Project Management**: Network Techniques, PERT, CPM, Crashing.
3. **Management:** Functions of management, evolution of management thoughts, School of management, Modern management theories, MIS.
4. **Organization:** Organizational Structure, types, company formations, features of various ownerships, principle of authority, span of control.
5. **Material management:** Historic approach, material functions, inventory policies, VED techniques.
6. **Production Planning and Control:** Functions and roles, value analysis, production forecasting techniques.
7. **Quality Control:** Quality and reliability, SQC, acceptance sampling, TQM concept.
8. **Plant maintenance:** Preventive, productive, breakdown and scheduled maintenance, maintainability, TPM concept.
9. **Human Resource management:** Introduction, Theories and evolution, natures and functions of human resource management, Human resource planning, recruitment, selection and induction.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Khanna, O.P.	Industrial Engg and management	DhanpatRai& Sons
2.	Hicks, Phillips	Industrial Engg and management	
3.	Prasad, L.M.	Principles and practice of management	S. Chand & Sons
4.	Koontz, H &Weitirich, H.	Essentials of Management	McGraw Hill
5.	Beardwell& Holden	Human resource management	McMillan India
6.	Besterfield	Total Quality management	LPE

EE 1431	COMPUTER APPLICATIONS IN POWER SYSTEM Departmental Elective II Electrical Engineering Branch	L T P C 3 0 0 6

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303)

1. **Elementary Linear Graph Theory:** Incidence and network matrices. Calculation of Z-Bus, Y-Bus, Z-Loop by singular and non-singular transformations. Algorithm for the calculation of Z-Bus of singular and three phase network. Short circuit studies using Z-Bus, Y-Bus.
2. **Different Methods of Solution of Linear and Non-linear Algebraic Equations:** Gauss-Scidel, Gront relaxation, Newton-Raphson and iterative methods. Load flow studies by different methods, solution of the swing equations. Representation of off-load and on-load tap changing and phase-shifting transformers for the purpose of load flow studies.

3. **Central Computer Control and Protection:** Data collection and manipulation, supervisory control relay target logging, state estimation program, Operating procedure recommendations, automatic fault study and relay setting, power system stability monitoring, corrective action for stability problem.

4. Automatic generation control, economic dispatch, generation schedule, optimum unit commitment interchange negotiation, volt/ VAR dispatch, weather forecast analysis, load forecast – future, evaluation of proposed operation, system security, load flow calculations, environmental monitoring.

Reference Books:

S N	Author	Name of Book	Publisher
1.	Stagg and Al Albiad	Computer Application in Power System	McGraw Hill
2.	M.A. Pai.	Computer Techniques in Power System Analysis	TMH
3.	Wood and Wollenberg	Power generation and Control	John Williey
4.	George L. Kusic	Computer aided power system analysis	PHI

EE 1432 **COMPUTER AIDED DESIGN OF ELECTRICAL SYSTEMS** **L T P C**

Departmental Elective II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Electrical Machines-I (EE 1207), Electrical Machines-II (EE 1301), Power System I (EE 1205), Power System II (EE 1303)

1. General consideration for design: temperature rise, output coefficients, main dimensions, winding design; analysis of magnetic circuits, design of transformer and induction machine. Computer aided design.

2. Design of transmission & distribution system; design of substation.

3. Need for automating circuit design. Design methodologies. Custom vs. semi-custom design. Automatic layout generation. Simulation and timing analysis. Functional, gate-level, circuit level and mixed level simulation. Physical modelling on computers. Clocking issues. Design for testability and manufacturability.

4. Basic problems in modern power equipment and drive systems. Basic design methodology and engineering considerations. Computerisation of design procedures. Optimization techniques and their applications to design problems. Use of computer software with workstations and PCs. Design exercises.

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	A.K. Sawhney	A course in Electrical Machine Design	DhanpatRai
2.	B.C. Kuo	Automatic Control System	PHI
3.	S. K. Sen Programs	Principal of Electrical Machine Design with Computer	Oxford & IBH

EE 1433 **INTELLIGENT ALGORITHMS FOR POWER SYSTEMS** **L T P C**

Departmental Elective II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303)

Introduction to Artificial Neural Networks (ANNs), multilayer feed-forward networks, back-propagation training algorithm, radial basis function and recurrent networks. ANN based algorithms for load flow analysis, economic load dispatch, load forecasting, transient stability, and power system stabilizers. Introduction to genetic algorithms, Application of genetic algorithms for power system optimization.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Stamatios V. Kartalopoulos	Understanding Neural Networks and Fuzzy Logic	IEEE Press
2.	Simon Haykin	Neural Networks	Pearson Education Asia
3.	L. Davis	Handbook of Genetic Algorithms	Van Nostrand Reinhold
4.	M. M. Gupta	Intelligent Control System	IEEE Press

EE 1434 **ADVANCED POWER ELECRONICS AND DEVICES** **I T P C**

Departmental Elective II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power Electronics (EE 1306)

Resonant DC – DC converters: operation, characteristics, design equations, control techniques and application; SMPS: Forward, flyback, push pull operation, characteristics, design and control techniques; Current controlled PWM; Voltage source inverters – Bang-bang, SPWM and space vector modulation techniques; Resonant DC link voltage source inverters – operation characteristics, design and control; Non drive applications of power electronic inverters: UPS, induction heating, metal cutting, active power line conditioning; Drive application of inverters: Vector controlled and slip power controlled induction motor drive, self controlled synchronous motor drive – constant power factor and constant margin angle control; Permanent magnet synchronous motor drive, stepper motor drive and switched reluctance motor drive; Application of microprocessor, PC and DSP in machine drives – example with DC motor drive.

S. N.	Author	Name of Book	Publisher
1.	Philip T.Krein	Power Electronics	OUP
2.	Mohan, Undeland Robbins	Power Electronics & DC converters	Wiley
3.	Rashid M.	Power Electronics	PHI
4.	P.C.Sen	Power Electronics	TMH
5.	Fang Lin Luo	Power Electronics	CRP Press
6.	F.F.Mazda	Power Electronics Hand Book	Elsevier

EE 1435 **ADVANCED ENGINEERING MATHEMATICS** **L T P C**

Departmental Elective II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Mathematics I & Mathematics II

1. **Linear Algebra**: Matrices, Vector spaces over R and C, linear dependence and independence, subspaces, bases, Linear transformations, rank and nullity, matrix of a linear transformation. Inverse and Pseudo-inverse, Eigen values & Eigen vectors. Principle Component Analysis and Their significance and Application in Signal Processing and control.
2. **Complex Variable:** Derivation of Couchy-Rieman conditions, Equations, Poles & Zeroes, Mapping. Residue calculus technique, Contour integration technique. Conformal Mapping Application to Nyquist criteria. Evaluation of series using contour integration.
3. **Calculus:** Riemann's definition of definite integrals; Indefinite integrals; Infinite and improper integrals; Double and triple integrals (evaluation of Areas Volumes.)

4. **Vector Analysis:** Scalar and vector fields, differentiation of vector field of a scalar variable; Gradient, divergence and curl in Cartesian, cylindrical, Sperical and curvilinear coordinates; Higher order derivatives; Gauss and Stokes' theorems, Green's identities. Applications to Electromagnetism.

5. **Linear Programming:** Linear programming problems, basic solution, basic feasible solution and optimal solution; Graphical method and simplex method of solutions; Duality. Transportation and assignment problems.

6. **Transform Calculus:** Fourier Transform, Fourier Analysis and Laplace Transform And Their Application

7. **PDE:** Family of surfaces in three dimensions and formulation of partial differential equations; Solution of quasi-linear partial differential equations of the first order. Linear partial differential equations of the second order with constant coefficients, canonical form; Solution of Wave Equation, Heat equation, Laplace equation by Laplace and Fourier Transform Method

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Krysig	Advanced Engineering Mathematics	Willy Publication
2.	M D Singhania	Differential Equation	S Chand
3.	K B Dutta	Linear Algebra	LPE
4.	Murry R Spigel	Vector Analysis	Schaum Publications

EE 1436 **INTEGRATED CIRCUITS AND VLSI DESIGN** **L T P C**

Departmental Elective II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Analog Electronics (EE 1203)

MOS transistor (enhancement and depletion). Basic inverter in NMOS and CMOS technology, E/D logic. Gates in NMOS and CMOS technology. Pass transistor. Introduction to NMOS and CMOS design methodology. Design rules, stick diagrams, poly-cell and gate array approaches. Examples of cell design. Software tools for design. Circuit and logic simulation. Layout generation and verification.

EE 1437 **PROCESS CONTROL** **L T P C**

Departmental Elective II **3 0 0 6**

Electrical Engineering Department

Prerequisite: Instrumentation (EE 1309), Control System –I (EE 1302)

Module 1:

Process characteristics: Incentives for process control, Process Variables types and selection criteria. Process degree of freedom, Period of Oscillation and Damping, Characteristics of physical System: Resistance, Capacitive and Combination of both. Elements of Process Dynamics, Types of processes- Dead time, Single /multicapacity, Self-Regulating /non self-regulating, Interacting /no interacting, Linear/nonlinear, Selection of control action for them, Study of Liquid Processes, Gas Processes, Flow Processes, Thermal Processes in respect to above concepts

Module2:

Analysis of Control Loop: Steady state gain, Process gain, Valve gain, Process time constant, Variable timeConstant, Transmitter gain, linearizing an equal percentage valve, Variable pressure drop analysis of Flow Control, Pressure Control, Liquid level Control, Temperature control, SLPC-features, faceplate, functions, MLPC- features, faceplate, functions, SLPC and MLPC comparison, scaling: types of scaling, examples of scaling.

Module 3:

Feedback Control: Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control Approach to Process Control.

Factors in Controller Tuning, Determining Tuning Constants for Good Control Performance, Correlations for tuning Constants, Fine Tuning of the controller tuning Constants. The performance of feedback Systems, Practical Application of Feedback Control: Equipment Specification, Input Processing, Feedback Control Algorithm, Output Processing.

Module 4:
Multi Loop & Nonlinear Systems: Cascade control, Feed forward control, feedback-feed forward control, Ratio control,Selective Control , Split range control- Basic principles, Design Criteria , Performance,Controller Algorithm and Tuning, Implementation issues, Examples and any special Features of the individual loop and industrial applications. Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance, Improvement in nonlinear process performance through Deterministic Control Loop Calculations, Calculations of the measured variable, final control element selection, cascade control design, Real time implementation issues

Module 5
Multivariable Control: Concept of Multivariable Control: Interactions and its effects, Modelling and transferfunctions, Influence of Interaction o the possibility of feedback control, important effects on Multivariable system behavior Relative Gain Array, effect of Interaction on stability and Multi loop Control system. Multi loop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	Donald Eckman	Automatic Process Control	Wiley Eastern Limited
2.	Thomas E Marlin	Process Control- Designing processes and Control Systems for Dynamic Performance	McGraw-HillInternational Editions
3.	F.G.Shinskey	Process Control System	TMH

EE 1441 **RESTRUCTURED ELECTRICAL POWER SYSTEM**

L	T	P	C
3	0	0	6

Departmental Elective III

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

1. **Overview of Key Issues in Electric Utilities Restructuring:** Introduction, restructuring models, independent system operator, power exchange, market operations, market power, stranded costs, transmission pricing , congestion pricing, management of inter zonal/ intra zonal congestion
2. **Open Access Same Time Information System:** Introduction, structure of OASIS, implementation of OASIS phases, posting of information, transfer capability of OASIS, transmission services, methodologies to calculate ATC, experience with OASIS in some restructuring models.
3. **Tagging Electricity Transactions:** Introduction, definitionof tagging, historical background on tagging, how does a tagging process work? Identifytags, dataelements of a tag, communication during failure recovery, transaction states, implementations, curtailment and cancellation of transactions.
4. **Electric Energy Trading:** Introduction, essences of electric energy trading, energy trading framework, derivative instruments of energy trading, portfolio Management, energy trading hubs, brokers in electricity trading, green power trading,.
5. **Hedging Tools for Managing Risk in Electricity Markets:** Introduction, risk, definition of hedge, sources of electricity market risks, value at Risk, counterparts risk, risk evaluation in electricity trading, hedging weather risk.

Reference Books:

SN	Author	Name of Book	Publisher
1.	Wood A and Wollenberg B	Power generation, Operation and control	Second Edition John Wiley & Sons Inc.
2.	A Chambers	Merchant Power: A basic Guide	Pennwell Publishers
3.	M Crew	Deregulation and Diversification of Utilities	Kluwer Academic Press
4.	D Pilipovic	Energy Risk: Valuing and Managing Energy Derivatives	MC Graw-Hill
5.	Fallon W and Turner D	Managing Energy Price	Risk Books
6.	Fusaro P	Energy Risk Management: Hedging Strategies and Instruments for the international Energy Markets	McGraw-Hill, New York
7.	Gellings C	Effective power marketing	Pennwell Publishers
8.	Jorion P	Value at Risk	McGraw Hill, New York
9.	Shahidehpour M and Marwali	Maintenance Scheduling in a Restructured Power System	Kluwer Academic Press

EE 1442 **ELECTRICAL NETWORKS AND PRICING** **L T P C**

Departmental Elective III **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303)

1. Introduction to restructuring of power industry, Fundamentals of economics, Philosophy of market models, Transmission congestion management, Locational Marginal Prices (LMP) and Financial Transmission Rights (FTR).
2. Pricing of transmission network usage and loss allocation: Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and demerits of different paradigms, Debated issues in transmission pricing, Classification of loss allocation methods, comparison between various methods.
3. Introduction to optimal bidding by a generator company, optimal bidding methods.

Reference Books:

SN	Author	Name of Book	Publisher
1.	D. Kirschen and G. Strbac	Fundamentals of Power System Economics	John Wiley & Sons Ltd.
2.	S. Hunt	Making Competition work in Electricity	John Wiley & Sons Ltd
3.	K. Bhattacharya, J.E. Daadler, M.H.J. Bollen	Operation of Restructured Power Systems	Kluwer Academic Publishers

EE 1443 **ELECTRIC POWER UTILISATION AND TRACTION** **L T P C**

Departmental Elective III **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) and Power System II (EE 1303)

Part-I

1. **Traction System:** Classification, brief explanation, Electric Traction - Different types, distinguishing features, advantages and disadvantages, Factors affecting final choice of Traction system.
2. **Power Supply System for Track Electrification:** Different systems of track electrification, block diagram representation, Advantages and disadvantages.
3. **Power Supply Arrangement:** Constituents of ac power supply system, layout and brief description of each of the constituents, miscellaneous equipments at control posts and major equipments at ac substation, Functions of dc traction sub-station.
4. **Overhead Equipment:** Various current collection system, brief description & areas of application, Constructional details of OHE employing single catenary and supported by swiveling type bracket assembly, Automatic weight tension and temperature compensation scheme, Factors determining the height, span of contact wire, Types of OHE supporting structure.
5. **Traction Mechanics and its applications:** Types of train services and their distinguishing features, Train resistance, adhesion, Train movements and Energy consumption. Speed-time curve, simplified sp-time curve; Tractive and relevant problems, multiple unit control and metadyne control.

Part - II

6. **Electric Heating:** Advantages of electric heating, Different methods of electric heating, their working principle; Brief idea about practical oven/furnace (To show the physical positions of main components only), range of operating temp., idea about current and voltage magnitudes used, application area, Different types of heating material electrode and their characteristics, causes of failure of heating element, Methods of controlling the temp. in the oven/furnace, Calculations relating to power input/output and design of main parameters of the furnace.

Part - III

7. **Illumination:** Classification of lamps based on the principle of operation; Different accessories required in each case and their circuit connection, Performance comparison with reference to lumen/watt efficiency, installation cost, length of life and quality of service, Method of design of lighting systems with simple problem.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	H. Partab	Modern Electric Traction	DhanpatRai&Co.P.Ltd.
2.	H. Partab.	Art and Science of Utilization of Electrical Energy	DhanpatRai&Co.P.Ltd.

EE 1444	SMART SENSORS	L	T	P	C
	Departmental Elective III	3	0	0	6
	Electrical Engineering Branch				

Prerequisites: Introduction to Computing (CS 1101)

1. **Smart Sensors Fundamentals:** Basic sensor technology Sensor systems; Smart sensors definitions;
2. **Smart Sensors:** Characteristics; Smart sensors architectures; Smart sensors buses and interfaces; Smart sensors software; Data acquisition methods for smart sensors; Virtual sensor systems; Smart sensors for electrical and non-electrical variables;
3. **Sensor Networks Architectures:** Single node architecture; Multi node architectures; Design principles; Energy efficient topologies; Wired sensor networks and wireless sensor networks; Applications;
4. **Communication Protocols:** Physical layer; MAC protocols; Link layer protocols; Localization and positioning; Routing protocols; Transport layer; Data gathering and processing: Protocols for gather information; Data processing techniques;
5. **Energy Management:** Energy consumption of sensor nodes; Techniques for reducing consumption and communication energy; Energy aware routing;
6. **Security, Reliability and Fault-Tolerance:** Security and privacy protection; Reliability
7. support; Fault-tolerance;
8. **Sensor Networks Standards; Platforms and Tools:** IEEE 802.15.4 and IEEE 802.11; Berkeley motes; Operating systems.

Reference Books:

SN	Author	Name of Book	Publisher
1.	N. V. Kirianaki, S. Y. Yurish, N. O. Shpak V. P. Deynega	Data Acquisition and Signal Processing for Smart Sensors	John Wiley
2.	H. Karl, A. Willig	Protocols and Architectures for Wireless Sensor Networks	John Wiley
3.	M. Ilyas, I. Mahgoub	Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems	CRC

EE 1445	OPTO-ELECTRONICS AND FIBER OPTICS	L	T	P	C
	Departmental Elective III	3	0	0	6
	Electrical Engineering Department				

Prerequisites: Analog Electronics (EE 1203), Digital Electronics (EE 1208)

1. **Elements of Light And Solid State Physics:** Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device.
2. **Display Devices and Lasers:** Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, laser applications.
3. **Optical Detection Devices:** Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.
4. **Optoelectronic Modulator:** Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustic devices, Optical, Switching and Logic Devices.
5. **Optoelectronic Integrated Circuits:** Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

6. **Optical Fibers:** Fiber Structures and Types, Rays and Modes Single-mode and Multimode Fibers, Refractive Index Profiles, Graded Index Fiber Numerical Aperture, Acceptance Angle, V-Parameter. Loss mechanisms in Fibers, Loss vs. Wavelength Plot and Its Significance Dispersion Mechanisms in Fibers: Intermodal and Intra-modal (Chromatic) Dispersions, Components of Intra-modal Dispersions, Dispersion vs. Wavelength Plots and Their Significance.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	J. Wilson and J.Haukes	Opto Electronics – An Introduction	Prentice Hall of India Pvt. Ltd., New Delhi
2.	Pallab Bhattacharya	Semiconductor Opto Electronic Devices	Prentice Hall of India Pvt., Ltd., New Delhi
3.	Jasprit Singh	Opto Electronics – As Introduction to materials and devices	McGraw-Hill International Edition

EE 1446 **L T P C**

WIND AND SOLAR ENEGY SYSTEMS **3 0 0 6**

Departmental Elective III

Electrical Engineering Department

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

Introduction to Solar Energy: Recent trends in energy consumption – World energy scenario– Energy sources and their availability – Conventional and renewable sources – Need to develop new energy technologies –Solar radiation and measurement – Solar cells and their characteristics – Influence of insulation and temperature – PV arrays – Electrical storage with batteries – Solar availability in India – Switching devices for solar energy conversion –
Stand alone inverters – Charge controllers – Water pumping – Audio visual equipments, Street lighting, Analysis of PV systems

Power Conditioning Converters: DC Power conditioning converters – Maximum Power point tracking algorithms – AC power conditioners – Line commutated inverters – synchronized operation with grid supply – Harmonic problem

Wind Energy Conversion System: Basic principle of wind energy conversion – nature of wind – Wind survey in India – Power in the wind – components of a wind energy conversion system – Performance of Induction Generators for WECS – Classification of WECS

Induction Generator: Self excited Induction Generator for isolated Power Generators – Theory of self-excitation – Capacitance requirements – Power conditioning schemes – Controllable DC Power from SEIGs

Optimisation Technique: Wind / Solar PV integrated systems – selection of power conversion ratio – Optimization of system components – Storage

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Rai G.D.	Non – Conventional Energy Sources	Khanna Publishers, 1993
2.	Rai G.D.	Solar Energy Utilisation	Khanna Publishers, 1993
3.	Daniel, Hunt V	Opto Electronics – As Wind Power – A Handbook of WECS	Van Nostrend Co., New York, 1981
4.	Gary L. Johnson	Wind Energy Systems	Prentice Hall Inc., 1985
5.	Freris L. L.	Wind Energy Conversion	Prentice Hall (UK) Ltd., 1990

EE 1447 **INTELLIGENT CONTROL** **L T P C**

Departmental Elective III **3 0 0 6**

Electrical Engineering Department

Prerequisites: Introduction to Computing (CS 1101)

Introduction to Intelligent control and comparison study between conventional control and intelligent control. Intelligent supervisory control, intelligent adaptive control

Introduction to Neural Network. Intelligent Control using Neural Network, Approximation capabilities by feed forward and recurrent Neural Networks, Neuro-control based on Back propagation algorithm, System identification with neural network

Introduction to Fuzzy Logic. Application of Fuzzy logic in Control System, Fuzzy quantization of knowledge, Fuzzy controller design

Genetic Algorithm Based Control System, Optimization based on Genetic Algorithm, Particle Swamp Optimization and its Application in Control System

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	M.M Gupta & N.K Sinha	Intelligent Control Systems	IEEE Press
2.	Goldberg	Genetic Algorithm	Pearson Education

EE 1448 **SWITCHED MODE POWER CONVERSION** **L T P C**

Departmental Elective III **3 0 0 6**

Electrical Engineering Department

Prerequisites: Analog Electronics (EE 1203), Digital Electronics (EE 1208), Power Electronics (EE 1306)

Switched mode power conversion – Overview; Switching power converters - circuit topology, operation, steady-state model, dynamic model: Non-isolated converters; Isolated converters; CCM and DCM operation of converters;

Modelling DC-DC converters: State space representations, Circuit Averaging, State Space Model of Boost Converter; DC-DC converter controller: Controller Structure, PID Controllers, Pulse width modulation, Controller design principles, Controllers and Sensing Circuit, Current Control, Unity Power Factor Converter; DC-DC Converter Design examples; Resonant Converters; Parallel loaded and series loaded resonant converters; transfer characteristics; design.

Basic two-level inverters: topology derivation and switching schemes; PWM methods: sine-triangle and space-phasor methods; Multi-level inverters: basic topology derivation and introduction to PWM schemes for multi-level inverters.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Robert Ericksson&DraganMaksimovic	Fundamentals of Power Electronics	Kluwer Academic publishers
2.	Ned Mohan, Tore M Undeland& W. P. Robbins	Power Electronics	John Wiley.
3.	Joseph Vithayathil	Power Electronics – Principles and Applications	McGraw Hill.
4.	Middlebrook, R. D. (Robert David), and Slobodan Cuk	Advances in Switched-Mode Power Conversion, Volumes I and II	TESLAco, 1983.
5.	Erickson, Robert W. Electronics	Fundamentals of Power	Chapman & Hall, 1997.

6.	V. Ramanarayanan	Course Material on Switched Mode Power Conversion	Department of Electrical Engineering, Indian Institute of Science, Bangalore 560012.

EE 1451 **DISTRIBUTION SYSTEM PLANNING AND AUTOMATION** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

Configuration of distribution systems, load characteristics, distribution transformers, distribution substation design, feeder design, voltage regulation, protection in distribution systems, SCADA, distribution automation.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	M.K.Khualkaret al	A textbook of electric power distribution automation	Laxmi publications Ltd.
2.	TarunGonen	Electric power distribution Engineering	CRC Press (3rd Edition)

EE 1452 **DEMAND SIDE MANAGEMENT** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

The concepts of demand-side management (DSM) for electric utilities, DSM alternatives and goals. End-use equipment and control, utility equipment control, energy storage, dispersed generation, customer DSM promotions. Performance improvement equipment and system benefit/cost analysis of DSM alternatives: issues in forecasting DSM programme impacts. Implementation of DSM programme: pricing and incentives.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	FawarElkarmi et al	Power System Planning Technologies and application	IGI Global
2.	Clark W Gellings et al	Demand-Side management planning	Fairmont Press

EE 1453 **MODELING, ANALYSIS AND CONTROL OF ELECTRICAL MACHINES** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Electrical Machines-I (EE 1207), Electrical Machines-II (EE 1301)

Principle of unified machine theory, generalized torque equation. Voltage and torque equation of dc machine, Performance evaluation of DC machine and speed control. Application of reference frame theory to three phase symmetrical induction and synchronous machines, dynamic direct and quadrature axis model in arbitrarily rotating reference frames, voltage and torque equations, corresponding equivalent circuits, derivation of steady state phasor relationship from dynamic model. Concept of Space vector, field oriented control and direct torque control of IM & SM.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	C.V. Jones	The Unified Theory of Electrical Machines	Butterworth, London, 1967
2.	P.Vas	Vector Control of A.C. Machines	Clarendon Press, Oxford 1990.
3.	J.M.D. Murphy & F.G. Turnbull	Power Electronic Control of AC motors	Pergamon Press, 1988
4.	W. Leonhard	Control of Electrical Drives	Springer Verlag, 1985.
5.	P.C. Krause	Analysis of Electric Machinery	McGraw Hill, New York, 1987
6.	B. K. Bose	Modern Power Electronics and A.C. Drives	PHI, 2002

EE 1454 **MODELING AND SIMULATION** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

1. **System Models and Role of Simulation:** Basic concepts and nomenclature, Types of system- Deterministic, Stochastic, Continuous and Discrete Systems, System Simulation – Uses of simulation and its limitation, Steps in simulation studies.
2. **Statistical Tool:** Generation and testing of pseudorandom numbers, Random variable generation for Uniform, Exponential, Normal and Poisson distributions, Sampling and Estimation, Maximum likelihood estimation, Confidence interval estimation.
3. **Discrete Event Simulation:** Representation of time, Approach to discrete event simulation, Queuing models – Single and multiserver queues, Steady state behavior of queues, Network of queues, Inventory System simulation, Programming languages for discrete system simulation. – GPSS, SIMSCRIPT (Brief Overview)
4. **Modeling and Performance Evaluation of Computer Systems:** Behavioral, Data flow and structural modeling, Overview of Hardware, Modeling and Simulation, Simulation for behavioral model, Evaluation of multiprocessor systems, workload characterization and Benchmarks.
5. **Continuous System Simulation:** Continuous System Models – Open and closed loop systems, Models described by differential equations, Systems Dynamics, Growth and decay models, Systems dynamics diagram, Simulations of aircraft models, Biological and sociological systems simulation, Simulation Languages Overview – CSMP.
6. **Virtual Reality Modeling:** Overview of Virtual Reality Modeling Language VRML 20, Creating dynamic worlds, Integrating JavaScript's with VRML
7. **Verification and Validation of Simulation Models:** Goals of Model Verification and Validation, Input data Analysis, Output analysis, Sensitivity analysis, Hypothesis testing, Performance measures and their estimation.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	J.E. Banks,	Discrete System Simulation	Prentice Hall
2.	G. Gordon	System Simulation	Prentice Hall India
3.	D. Ferrari	Computer Systems Performance Evaluation,	Prentice Hall
4.	J. Bhastav	A VHDL Primer	Prentice Hall

EE 1455 **ILLUMINATION TECHNOLOGY** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Basic Electrical Engineering (EE 1101),Power System-I (EE1205)

Radiation, colour, eye & vision; Different entities of illuminating systems; Light sources; incandescent, electric discharge, fluorescent, arc lamps and lasers; Luminaries and light guides, control of light, control circuitry and computer based lighting control.

Laws of illumination; illumination from point, line and surface sources. Photometry and spectrophotometry; Photocells. Environment and glare. General illumination design. Interior lighting-industrial, residential, office departmental stores, indoor stadium, theater and hospitals. Exterior lighting - flood street, aviation and transport lighting, lighting for displays and signaling-neon signs, LED-LCD displays beacons and lighting for surveillance.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Jack L. Lindsey	Applied Illumination Engineering	The Fairmont Press
2.	Ronald N Helmis et al	Lighting for energy efficient luminous environments	Prentice Hall
3.	Mare Schiler	Simplified design of building lighting	John Willey and Ser

EE 1456 **RENEWABLE ENERGY SOURCES AND MANAGEMENT** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

1. **Introduction**: Energy situation and renewable energy sources. Global energy scene, firewood crisis, Indian energy scene. Nonconventional renewable energy sources, potential of renewable energy sources.
2. **Solar Radiation:** Terrestrial solar radiation, measurement of solar radiation.
3. **Low Temperature Collectors:** Flat plate collectors, optical characteristics of absorber and cover, heat transfer and transmission losses, collector model, collector equations.
4. **Applications of Solar Energy:** Solar drying, solar distillation, solar air conditioning and refrigeration.
5. Photo voltaic energy conversion. Solar cell, equivalent circuit diagram.
6. **Bioconversion:** Biomass, physical and biological thermal methods of bioconversion. Solid fuels, ethanol, methanol, vegetable oils. Biomass fuels in IC engines. Alcohol fuels, vegetable oils, producer gas.
7. **Wind Energy**: Origin, direction, velocity and measurement of wind. Wind energy converters - power coefficient, aerodynamic construction of rotor blade. Wind electric generators in India.
8. **Other Energy Sources**: Wave energy, tidal energy, ocean thermal energy conversion (OTEC).
9. **Energy Management & Conservation**: Energy management, energy surveying and auditing, flowchart for construction of energy, audit, energy indices, heating energy characteristic, energy output, effects of energy conservation on energy characteristic, energy saving options.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Bansal, N.K.; Kleemann, M & Meliss, M.	Renewable energy sources and conversion Technology	TMH
2.	Kristoferson, L.A & Bokalders, V.	Renewable energy Technologies;	Pergamon
3.	O'Callaghan, P	Energy Management	McGraw Hill

EE 1457 **NONLINEAR CONTROL SYSTEMS** **L T P C**

Departmental Elective IV **3 0 0 6**

Electrical Engineering Department

Prerequisite: Control Systems-I (EE 1302), Control Systems-II (EE 1305)

Module I: Introduction to nonlinear feedback control systems. Characteristics of common nonlinearity and their classification. Concept of equilibrium/singular points. Comparison between linear and nonlinear systems.

Module II: Phase plane analysis, Different cases of Phase portraits of Standard 2^{nd} order system. Phase Plane Analysis of nonlinear system. Stability study by phase plane analysis. Concept of limit cycle and its classification.

Module III: Frequency domain Analysis of Nonlinear System: Describing function, Stability analysis of a nonlinear systems using Describing function.

Module IV: Lyapunov's stability analysis, Input-State Stability, I/P Output Stability, Passivity, Stability of perturbed system, Perturbation theory and averaging, Singular Perturbation

Module V: Feedback Control of Nonlinear System, Feedback Linearization, I/P-O/P Linearization,

Module VI: Nonlinear Controller Design, Sliding Mode Control, Backstepping Control, Lyapunov's redesign, Passivity Based Control. High Gain Observers

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	Slotine/ Li	Applied Non Linear Control	Prentice Hall
2.	Hassan K Khalil	Nonlinear Systems	Prentice Hall

EE 1461 **POWER QUALITIES** **L T P C**

Departmental Elective V **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

Overview and definition of power quality PQ). Sources of pollution. International power quality standards, and regulations, Power quality problems: rapid voltage fluctuations, voltage imbalance, voltage and voltage swells, short duration outages. Power system harmonics: harmonic analysis, harmonic sources – static converters, transformer magnetization and non-linearities, rotating machines, arc furnaces, fluorescent lighting. Harmonic effects within the power system, interference with communication. Harmonic measurements. Harmonic elimination - harmonic filters.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	MHJ Bollen	Understanding Power Quality Problems	IEEE Press
2.	Roger C.Dugan et al	Electrical Power Systems Quality	McGraw Hill
3.	Arindam Ghosh, Gerard Ledwich	Custom Power Devices: An Introduction	Springer

EE 1462 **POWER SYSTEM RELIABILITY** **L T P C**
Departmental Elective V **3 0 0 6**
Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

Load Forecasting: Load Forecasting Categories-Long term, Medium term, short term, very short term Applications of Load Forecasting, Factors Affecting Load Patterns Medium and long term load forecasting methods- end use models, econometric models, statistical model based learning. Short Term Load Forecasting (STLF): Applications of Load Forecasting, methods- similar day approach, regression methods, time series, ANN, Expert systems,

Power System Reliability: Basic Notions of Power System Reliability- sub systems, reliability indices, outage classification, value of reliability tools, Concepts and methodologies, power system structure, Reliability based planning in power systems, Effect of failures on power system, Planning criteria, Risk analysis in power system planning, multi-state systems.

Basic Tools and Techniques- random processes methods & Markov models, Computation of power system reliability measures by using Markov reward models, Evaluation of reliability indices, Universal Generating Function (UGF) Method, Monte Carlo simulation.

Reliability of Generation Systems- capacity outage calculations, reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion,

Reliability Assessment for Elements of Transmission and Transformation Systems- reliability indices of substations based on the overload capability of the transformers, evaluation and analysis of substation configurations, Reliability analysis of protection systems for high voltage transmission lines,.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Shahidehpour M, Yamin H, Li z	Market operations in electric power systems Forecasting, Scheduling, and Risk Management	John Wlley& sons
2.	Billinton R, Allan R	Reliability evaluation of power systems	Plenum Press New York
3.	D. Elmakias	Computational Methods in Power system Reliability	Springer-Verlag

EE 1463 **FOUNDATION IN OPTIMIZATION METHODS** **L T P C**
Departmental Elective V **3 0 0 6**
All Branches

Prerequisites: Introduction to Computing (CS 1101)

1. **Introduction**: Statement of optimization problem, classification.
2. **Classical Optimization Techniques:** Single variable Optimization. Multivariable optimization (with no constraints, equality constraint & inequality constraints).

3. **Linear Programming:** Standard form of linear programming problem, definition and theorem, Solution of a system of Linear simultaneous equation, Simplex methods, simplex algorithm, Two phases of simplex method, Duality in linear programming, sensitivity analysis, transportation problem.

4. **Non linear Programming:** One dimensional minimization: Unimodal function, elimination methods, Fibonacci method, Golden section method, quadratic interpolation method. Unconstrained Optimization: Direct search method, Hooke& Jeeves pattern search method. Descent method - Fletcher-Reeves method.

5. **Constrained Optimization**: Direct method - Cutting plane method, Indirect method - Penalty function method both interior and exterior method.

6. **Integer Programming:** Integer linear programming-graphical representation, cutting plane method. Nonlinear programming- Integer polynomial programming.

7. **Nontraditional Optimization Algorithm**: Genetic Algorithm - Working principle, Difference and similarities between GAs and traditional methods, GAs for constrained optimization.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Rao, S.S.	Optimization Theory and Application	New Age
2.	Deb, Kalyanmoy	Optimization for Engineering Design	PHI
3.	Arora, Jasbir, S.	Introduction to Optimum design	McGraw Hill
4.	Beighfler, C.S.	Foundations of Optimization	PHI
5.	Mital, K. V.	Optimization methods in Operation Research and System Analysis	New Age
6.	Phillip &Ravindran	Operation Research	John Willey & Sons

EE 1464	INDUSTRIAL INSTRUMENTATION Departmental Elective V Electrical Engineering Branch	L	T	P	C
		3	0	0	6

Prerequisites: Instrumentation (EE 1309)

Instrumentation in Industry:

Introduction, Use of instruments in Industry, A brief idea (block diagram) of the industrial applications of instruments in some process industries like Food, Palp and paper, Automotive Petroleum products industries, Instrument selection for the application.

Elements of Instrumentation:

Functional description of instrumentation system. Role of transducer, amplifiers, filters and display devices, Basic characteristics of OP-AMP, D.C. amplifier, Instrumentation amplifiers, signal conditioning, different types of filters and their characteristics. Different types of data display and recording system. Data loggers, magnetic tape recorders.

Transdusers and Instrumentation:

Active and passive transducers for measurement of displacement, force, pressure etc., Working principle of tachometer, Electromagnetic flow mater, magnetostrictive transducers, Working of feedback transducers like inverse transducers, temperature balance system, Feedback accelerometer, fiber optic sensors, electro-optical sensors in process industries.

Analytical Industrial Instrumentation:

Measurement of pressure, Measurement of flow, Measurement of Temperature, Measurement of viscosity, liquid level, humidity and vibration by using electrical or mechanical transducers, Gas chromatography.

Industrial Instrumentation with radio isotopes:

Nuclear radiation transducers, radioactive vacuum, Thickness and level gauges, Non Destructive Testing equipments-introduction, neutron radiography, signature analysis as NDT tool. Ultrasonic and ultrasonic holography.

Data Aquisition and Telemetry:
Digital Data acquisition system, Telemetry -Definition, classification, Frequency telemetry, Multiplexing and modulation in Telemetry. Remote control, general description, typical scheme of an industrial remote control system.

Microprocessor Based Instrumentation:
Motivation, basic structure, programming methods, Application examples Annunciator, stepper, motor control, Microprocessor based DAS. Control centre requisite, computer control systems. Power plant instrumentation schemes main parameters-simple analysis.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	D. Patranabis	Principles of Industrial Instrumentation	PHI
2.	C.S. Rangan et. al.	Instrumentation, Devices and Systems	TMH
3.	D.V.S. Murthy	Transducers and Instrumentation	PHI
4.	A.E. Fribance, Soisson, A.E. Fribance	Instrumentation in Industry	TMH
		Nuclear Radiation Detectors	Willey Interscience
		Industrial Instrumentation Fundamentals	TMH

EE 1465 **BIOMEDICAL ENGINEERING** **L T P C**
Departmental Elective V **3 0 0 6**
Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

1. **Introduction to Biomedical Instrumentation:** Introduction, Biometrics, physiological systems of the body, Biomedical Transducer, Sources of bio-electric signals, propagation of action potential, Electrodes: theory, physical sensors, chemical transducers.
2. **Cardio-vascular System and Electrocardiography:** The heart and cardiovascular system, Blood pressure, The heart sound, The electrocardiography
3. **Biomedical recorders:** Electrocardiograph(ECG), Phonocardiograph, Electroencephalograph (EEG), Electromyography (EMG)
4. **Implantable Bio-electric Devices:** Introduction, function of implantable electronic device, Implantable electrodes and leads, Cardiac pacemaker – types, working principle and performances, Implantable electrodes and leads
5. **Patient Care and Monitoring:** System concept and requirement, Measurement of blood: pressure, heart beat rate, temperature and respiration, The organization of the hospital for patient care monitoring, Defibrillators
6. **Biotelemetry:** Introduction, Classification and principles of biotelemetry, Ultrasound and light telemetry, Telephonic telemetry, Implantable units, Application of telemetry in patient care
7. **Medical Imaging:** Instrumentation for diagnostic X-rays, X-ray computed tomography, Basic NMR components, Ultrasonic, imaging systems – Medical ultrasound, A-SCAN, Echocardiograph (M-mode), B-SCANNER, Biological effect of ultra sound.
8. **Computers in Biomedical Instrumentation:** Database management: Introduction, in-house and commercially available systems, desirable features, specific medical application, Computerized critical care areas: Planning and designing a computerized critical care unit, selection of monitoring equipment, The computer in clinical laboratories, Computer in medical research : Introduction, interacting with experimental preparations, Artificial Intelligence : Introduction, medical applications of artificial intelligence, developing a medical expert system.
9. **Related Topics:** Hearing Aids – Hearing fundamentals, disorders.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	L. Cromwell *et al*	Biomedical Instrumentation and Measurements	Prentice Hall
2.	R.S. Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill
3.	Jacob Kline	Handbook of Biomedical Engineering	Academic Press.

EE 1466 **HYDRO-ELECTRIC ENGINEERING** **L T P C**

Departmental Elective V **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power System I (EE 1205) , Power System II (EE 1303)

Essential Features of Hydro-Electric Power Plant. Classification of Hydro-Electric Power Plants. Hydrology, Hydrologic Cycle, Hydrograph, Flow duration curve.

Size of plant and choice of units. Types of Turbine and their characteristics. Design of Main Dimensions of turbines. Draft tubes, types, setting and preliminary dimensions.

Pumped storage schemes. Mini and Micro Hydro Power Plants. Selection of turbine and pump capacities, Pumping schedule. Operation and efficiency of Pumped storage schemes.

Cost evaluation of hydro-electric plant. Co-ordination of different types of Power Plant in power system. Economic loading of hydro-power plants. Hydro-thermal mix. Types of Underground Power Plants. Largest Underground Power Plant. Elementary idea of the use of computers in power stations. Load dispatching. Power system security. Load forecasting. Generation allocation control. Generation system reliability.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	G.D. Rai	An Introduction to Power Plant Technology	Khanna
2.	G.R. Nagpal	Power Plant Engineering	Khanna
3.	M.V. Deshpandey	Elements of Electrical Power Station Design	Wheeler
4.	Mahesh Verma	Power Plant Engineering	Metropolitan Book Company

EE 1467 **ADVANCED CONTROL SYSTEM** **L T P C**

Departmental Elective V **3 0 0 6**

Electrical Engineering Department

Prerequisite: Control Systems-I (EE 1302) , Control Systems-II (EE 1305)

Module –I: System Identification: Identification of dynamic models of simple systems, recursive and non-recursive least square estimation.

Module –II: Optimal Control: Concept of functional, Application of variational calculus to control problems, optimal solution of LQR problem, Stability and robustness properties of LQR design.

Module –III: Robust Control: Robustness and Sensitivity, Concept of system and signal norms. Small-gain theorem, Computation of $H\infty$ norm and its physical interpretation, $H\infty$ control

Module –IV: Adaptive Control: Gain scheduling, Model Reference Adaptive Control, Adaptive Pole Placement Control.

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	D S Naidu	Optimal Control systems	CRC Press
2.	IOANNOU	Robust Adaptive Control	PTR
3.	T. Söderström and PetreStoica	System Identification	Prentice-Hall, 1989

EE 1468 **POWER ELECTRONIC CONTROL OF AC DRIVES** **L T P C**

Departmental Elective V **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Power Electronics (EE 1306), Industrial Drives (EE 1402)

UNIT – 1: AC Machines for Drives:

Induction Machines- torque production – equivalent circuit analysis; speed torque characteristics with

- variable voltage operation, variable frequency operation, constant v/f operation
- variable stator current operation
- Induction motor characteristics in constant torque and field weakening regions.

UNIT – II: Control and Estimation of Induction Motor Drives

Scalar control:

- voltage fed inverter control- open-loop volts/Hz control-speed control slip regulation, speed control with torque and flux control, current controlled voltage fed inverter drive
- current fed inverter control: independent current and frequency control, speed and flux control in current–fed inverter drive, Volts /Hz control of current-fed inverter drive ,
- Slip power recovery drives –static Kramer Drive – Phasor diagram- torque expression – speed control of Kramer Drive – Static Scheribus Drive – modes of operation.

UNIT – III: Vector or Field Oriented Control of Induction motor drives:

DC Drive Analogy-Principles of Vector control

- vector control methods
- direct vector control
- Indirect vector control.

UNIT – IV: Control and Estimation of synchronous motor drives:

- Synchronous motor and its characteristics –
- Control strategies – constant torque angle control, unity power factor control, constant mutual flux linkage control - Flux weakening operation – maximum speed – direct flux weakening algorithm – constant torque mode controller – flux weakening controller – indirect flux weakening – maximum permissible torque – speed control scheme – implementation strategy – speed controller design.

UNIT – V: Brushless DC motor drives:

Three-phase full wave brush less dc motor

- sinusoidal type of brush less dc motor
- Current controlled blushless dc motor servo drive.

Reference Books:

SN	Author	Title	Publisher
1.	B.K. Bose	Modern Power Electronics and AC drives	Pearson publications
2.	R. Krishnan	Electric motor drives Modeling, Analysis and Control	Pearson Publications
3.	B.K. Bose	Power Electronics and AC drives	Prentice Hall
4.	M.H. Rashid	Power electronic circuits, Devices and applications	PHI
5.	G.K. Dubey	Fundamentals of Electrical drives	Narosa publications
6.	B.K. Bose	Power Electronics and Variable frequency drives	IEEE Press Standard publications, 1st Edn,

EE 1471	SOFT COMPUTING TECHNIQUES AND APPLICATIONS	L	T	P	C
	Open Elective I	3	0	0	6

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

Introduction to soft computing, intelligent decision system, overview of soft computing techniques.

Introduction to genetic algorithm, genetic operators and parameters, genetic algorithms in problem solving, theoretical foundations of genetic algorithms, evolutionary programming, particle swarm optimization, differential evolution; implementation issues and applications.

Neural model and network architectures, perceptron learning, supervised hebbian learning, backpropagation, associative learning, competitive networks, hopfield network, computing with neural nets and applications of neural network. case-based reasoning (CBR), applications of CBR.

Introduction to fuzzy sets, operations on fuzzy sets, fuzzy relations, fuzzy measures, applications of fuzzy set theory to different branches of science and engineering.

MATLAB tutorial

Application of soft computing to control systems

Application of soft computing to decision-support systems

Application of soft computing to image processing and data compression

Application of soft computing to handwriting recognition

Application of soft computing to automotive systems and manufacturing

Application of soft computing to architecture

Application of soft computing to power systems

Fuzzy logic control

Neuro-fuzzy systems

Reference Books:

SN	Author	Name of Book	Publisher
1.	D. E. Goldberg	Genetic Algorithms in Search, Optimization, and Machine Learning	Addison-Wesley
2.	Z. Michalewicz	Genetic Algorithms+ Data Structures + Evolution Programs	Springer-Verlag
3.	N. K. Sinha & M. M. Gupta (Eds)	Soft Computing & Intelligent Systems: Theory & Applications	Academic Press
4.	M.T. Hagan, H. B. Demuth, and M. Beale	Neural Network Design	Thompson Learning
5.	S. Haykin	Neural Networks- A Comprehensive Foundation	PHI
6.	C. Lau (Ed)	Neural Networks	IEEE Press
7.	Satish Kumar	Neural Networks- A Classroom Approach	TMH
8.	G. J. Klir, and B. Yuan	Fuzzy Sets and Fuzzy Logic: Theory and Applications	PH
9.	H. J. Zimmerman	Fuzzy Set Theory and Its Applications	Kluwer Academic Pr

EE 1472 **DATA WAREHOUSING AND DATA MINING** **L T P C**

Open Elective I **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

Introduction [2L]: Data warehousing – definitions and characteristics, multi-dimensional data model, warehouse schema.

Data Marts [4L]: Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart.

Online Analytical Processing [4L] : OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi-dimensional view, snowflake schema; OLAP tools.

Developing a Data Warehousing [4L] : Building of a Data Warehousing, Architectural strategies & organizational issues, design considerations, data content, distribution of data, Tools for Data Warehousing

Data Mining [4L] : Definitions; KDD(Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges; Applications of Data Warehousing & Data mining in Government.

Association Rules [4L]: A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP –tree growth algorithm; Generalized association rule.

Clustering Techniques [4L]: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; Categorical clustering, STIRR, ROCK, CACTUS.

Decision Trees [4L]: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Web Mining [4L]: Web content Mining, Web structure Mining, Web usage Mining, Text Mining.Temporal and Spatial Data Mining [5L] : Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.

Reference Books:

SN	Author	Name of Book	Publisher
1.	Prabhu	Data Warehousing –Concepts, Techniques, products, application	PHI
2.	A. K. Pujari	Data Mining Techniques	Universities Press
3.	Alex Berson and Stephen J Smith	Data Warehousing, Data Mining and OLAP	TMH
4.	Anahory	Data Warehousing in the real world	Pearson Education
5.	Dunham	Data Mining Introductory & Advanced Topic	Pearson Education

EE 1473 **NEURAL NETWORKS AND FUZZY LOGIC** **L T P C**

Open Elective I **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

Unit-I

Neural Networks Characteristics: History of Development in neural networks, Artificial neural net terminology, model of a neuron, Topology, Types of learning. Supervised, Unsupervised learning. Basic Learning laws, Hebb's rule, Delta rule, Widrow and Hoff LMS learning rule, correlation learning rule instar and ouster learning rules.

Unit-II

Unsupervised Learning: Competitive learning, K-means clustering algorithm, Kohonen's feature maps. Radial Basis function neural networks- recurrent networks, Real time recurrent and learning algorithm. Introduction to Counter propagation Networks- CMAC Network, ART networks, Application of NN in pattern recognition, optimization, Control, Speech and decision making.

Unit-III

Fuzzy Logic: Basic concepts of Fuzzy logic, Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of Fuzzy sets, Fuzzy if-then rules, Variables inference techniques, defuzzification techniques, basic Fuzzy interference algorithm, application of fuzzy logic , Fuzzy system design implementation , useful tools supporting design.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	BerkinRiza C and Trubatch	Fuzzy System design principles- Building Fuzzy IF-THEN rule bases	IEEE Press
2.	Yegna Narayanan	Artificial Neural Networks	8th Printing. PHI(2003)
3.	Patterson Dan W	Introduction to artificial Intelligence and Expert systems	3rd Ed., PHI
4.	Simon Haykin	Neural Networks	Pearson Education
5.	Yen and Langari	Fuzzy Logic: Intelligence, Control and Information	Pearson Education
6.	Jacek M Zaurada	Introduction to artificial neural Networks	Jaico Publishing Home

EE 1474 EVOLUTIONARY ALGORITHMS IN SEARCH & OPTIMIZATION L T P C

Open Elective I 3 0 0 6

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

1. Introduction, Principles of Evolutionary Processes and Genetics, History of Evolutionary Computation, Introduction to Evolutionary Algorithms, Genetic Algorithms, Evolutional Strategies. Evolutionary Programming, Derivative Methods in Genetic Programming, Learning Classifier Systems, Hybrid Methods.
2. Introduction to Representations, Binary Strings, Real-Valued Vectors Permutations, Finite-State Representations, Parse Trees.
3. Introduction to Selection, Proportional Selection and Sampling Algorithms, Tournament Selection, Rank-based Selection, Boltzmann Selection, Generation Gap Methods, A comparison of Selection Mechanisms, Introduction to Search Operators, Mutation Operators, Recombination.
4. Problem Solving Paradigms: survey of applications involving search, optimization and machine learning.
5. Formal Models and Comparative Analysis, Survey of EA theory, Recent Developments and Future Directions.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	K. De Jong	Evolutionary Computation: A Unified Approach	MIT Press
2.	Fogel, D.B.	Evolutionary Computation: Toward a New Philosophy of Machine Intelligence	Wiley-IEEE Press
3.	Back, T.	Evolutionary Computation 1: Basic Algorithms and Operators	Institute of Physics Publishing, Bristol

EE 1475	INFORMATION SECURITIES	L	T	P	C
	Open Elective I	3	0	0	6

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

UNIT - 1: INTRODUCTION
History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT - 2: SECURITY INVESTIGATION
Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues

UNIT - 3: SECURITY ANALYSIS
Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk

UNIT - 4: LOGICAL DESIGN
Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT - 5: PHYSICAL DESIGN
Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	Michael E Whitman and Herbert J Mattord	Principles of Information Security	Vikas Publishing House, New Delhi, 2003
2.	Micki Krause, Harold F. Tipton	Handbook of Information Security Management	Vol 1-3 CRC Press LLC, 2004
3.	Stuart McClure, Joel Scrambray, George Kurtz	Hacking Exposed	Tata McGraw-Hill, 2003
4.	Matt Bishop	Computer Security Art and Science	Pearson/PHI, 2002

EE 1476	DATABASE MANAGEMENT SYSTEM	L	T	P	C
	Open Elective I	3	0	0	6

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

1. **Introduction :** Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.
2. **Entity-Relationship Model:** Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.
3. **Relational Model:** Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational AlgebraOperations, Views, Modifications Of the Database.
4. **SQL and Integrity Constraints:** Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL,PL/SQL, Stored procedures and triggers, Cursors.
5. **Relational Database Design**: Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, 1NF, 2NF, 3NF, Boyce-Codd Normal Form, Normalization using multi-valued dependencies, 4NF, 5NF, 6NF.

6. **Internals of RDBMS:** Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control & Recovery Management: transaction model properties, state serializability,lock based protocols, two phase locking, Deadlocks, Deadlock avoidance, Wait die & wound wait protocol.

7. **File Organization & Index Structures :**File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-LevelIndex (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+tree .

Reference Books:

SN	Author	Name of Book	Publisher
1.	Henry F. Korth and Silberschatz Abraham	Database System Concepts	Mc.Graw Hill
2.	ElmasriRamez and NovatheShamkant	Fundamentals of Database Systems	Pearson Education
3.	Ramakrishnan	Database Management System	McGraw-Hill
4.	Gray Jim and Reuter	Transaction Processing: Concepts and Techniques	Moragan Kauffman Publishers
5.	Jain	Advanced Database Management System	CyberTech
6.	Date C. J.	Introduction to Database Management	Addison Wesley. /Pearson Education
7.	Ullman JD.	Principles of Database Systems	Galgottia Publication

EE 1477 **CONTROL SYSTEM DESIGN** **L T P C**
Open Elective -I **3 0 0 6**
Electrical Engineering Branch

Prerequisites: Control System –I (EE 1302)

Module I: Brief Review of concepts of Linear Control System: Root Locus Approach, Bode Plot Method.

Module II:PID Controller Design, PID Tuning method and performance analysis, Lag-Lead Compensation, Smith's Predictor, Feed Forward Control

Module III: Pole Placement Method, State Observer based controller.

Module IV: Introduction to fractional calculus and its application to Control Systems. Fractional Order modelling of Physical system. Fractional Order PID Controller Design

Module V: Control System design using Quantitative feedback theory

Module VI: Controller Design to Real System: Speed and Position Control of DC motors, Inverted Pendulum, Magnetic Levitation System, Liquid Level Control System, Liquid Flow Control System etc.

SN	Author	Name of Book	Publisher
1.	G.C.Goodwin et al.	Control System Design	Prentice Hall
2.	Stefani et al.	Design of Feedback Control System	Oxford University Press
3.	C.A Manje et al.	Fractional Order Systems and Control	Springer
4.	Jhonson&Maradi	P.I.D Control	Springer
5.	CautantineH Hompes et al.	Quantitative Feedback Theory-Fundamentals and Application	CRC Press

EE 1481 **FINITE ELEMENT METHODS IN ENGINEERING** **L T P C**

Open Electives –II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Mathematics-I, Mathematics-II

1. **Introduction**: Solution to engineering problems – mathematical modeling – discrete and continuum modelling – need for numerical methods of solution – relevance and scope of finite element methods – engineering applications of FEA.

2. **Finite Element Formulation of Boundary Value Problems:** Weighted residual methods –general weighted residual statement – weak formulation of the weighted residual statement –comparisons – piecewise continuous trial functions, example of a bar finite element –functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element.

3. **One Dimensional Finite Element Analysis:** General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.

4. **Two Dimensional Finite Element Analysis:** Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – iso-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – need for quadrature formula – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and axis symmetric applications.

5. **Dynamic Analysis using Finite Element Method:** Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations –solution of eigen value problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	P. Seshu	Text Book of Finite Element Analysis	Prentice-Hall
2.	J. N. Reddy	An Introduction to the Finite Element Method	McGraw-Hill
3.	Chandrupatla&Belagundu	Introduction to Finite Elements in Engineering	Prentice-Hall
4.	David V. Hutton	Fundamentals of Finite Element Analysis	Tata McGraw-Hill
5.	Cook, Robert. D., Plesha, Michael. E & Witt, Robert. J	Concepts and Applications of Finite Element Analysis	Wiley

EE 1482 **HUMAN-COMPUTER INTERFACE** **L T P C**

Open Electives -II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

Introduction, Organizational and business context, Preview of HCI development methodology, Interactive technologies, Physical engineering, Cognitive engineering, Task analysis, Componential design, Affective engineering, Evaluation, HCI development methodology, Interpersonal relationship, Collaboration, and

Organization, Social and global issues, Meetig and changing needs of IT development and use, Future issues in HCI.

Reference Books:

S. N.	Author	Name of Book	Publisher
1.	Baecker, Grudin, Buxton, and Greenberg	Readings in Human-Computer Interaction: Toward the Year 2000	Morgan Kaufmann Publishers
2.	Dix, A., Finlay, J., Abowd, G., & Beale, R.,	Human-computer interaction	Prentice Hall Europe
3.	Te'eni, D., Carey, J. & Zhang, P.	Human-Computer Interaction: Developing Organizational Information Systems	John Wiley and Sons
4.	Shneiderman, Ben &Plaisant, Catherine	Designing the user interface: Strategies for effective human-computer interaction	Addison-Wesley/Pearson

EE 1483 **MACHINE INTELLIGENCE** **L T P C**

Open Electives -II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

Algorithmic models of learning. Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs from experience. Bayesian, maximum a posteriori, and minimum description length frameworks. Parameter estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers. Computational learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting. Dimensionality reduction, feature selection and visualization. Clustering, mixture models, k-means clustering, hierarchical clustering, distributional clustering. Reinforcement learning; Learning from heterogeneous, distributed, data and knowledge. Selected applications in data mining, automated knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human-computer interaction, semantic web, and bioinformatics and computational biology.

Reference Books:

Author	Name of Book	Publisher
Kevin P. Murphy	Machine Learning: A Probabilistic Perspective	MIT Press
Richard S. Sutton & Andrew G. Barto	Reinforcement Learning: An Introduction	MIT Press
Bishop, C	Pattern Recognition and Machine Learning	Berlin: Springer-Verlag
Bishop, C. M	Neural Networks for Pattern Recognition	New York: Oxford UnivPr
Duda, R., Hart, P., and Stork, D	Pattern Classification	New York: Wiley

EE 1484 **INTELLIGENT AND KNOWLEDGE BASED SYSTEMS** **L T P C**

Open Elective II **3 0 0 6**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101)

Problem solving: state space representation, problem reduction, constraint satisfaction networks. Heuristics. Knowledge Representation Predicate calculus, resolution-refutation, Prolog. Rule based systems: forward and backward chaining. Handling of uncertainty: probabilistic techniques, fuzzy logic. Reasoning with incomplete information: non-monotonic reasoning. Elements of temporal logic. Diagnostic reasoning. Structured Knowledge Representation Schemes: Semantic networks, Frames, Inheritance and default reasoning. Expert Systems: Architecture of the expert systems. Expert system shells. Knowledge acquisition. Consistency of the knowledge base. Case studies. Distributed AI and agent based systems.

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	G. J. Klir	Fuzzy Sets and Fuzzy Logic	PHI
2.	H. J. Zimmerman	Fuzzy Set Theory and its Applications	Kluwer Academic Publisher

EE 1485 **COMPUTER ORGANISATION AND ARCHETECTURE** **L T P C**

Open Elective II **3 1 0 8**

Electrical Engineering Branch

Prerequisites: Introduction to Computing (CS 1101), Analog Electronics(EE 1203) and Digital Electronics(EE 1208)

1. **Introduction**

   Computers and computations, Limitations of computers, First, second and third generation of computer families, The VLSI era: Integrated circuits, Microprocessors and Microcomputers, recent developments.

2. **Processor Design**

   Processor organization, information representation, number formats, Instruction sets: instruction formats, instruction types, execution of instructions, Fixed – point arithmetic: addition and subtraction, multiplication, division.

3. **Controller Design**

   Instruction sequencing and instruction interpretation, Hardwired control: design methods, multiplier control unit, CPU control unit, Micro-programmed control: basic concepts, control – memory optimization, multiplier control unit.

4. **Memory Organization**

   CPU – memory interaction, Memory array organization and technology, Multiple module memory, Virtual memory: Memory hierarchies, main – memory allocation, segment, pages and files.

5. **Input – Output Processing**

   Data transfer technique, Bus interface, IO accessing and data transfer, IO interrupts, IO Channel/ Processor.

6. **Peripheral Systems**

   Principles of DOT Matrix, inkjet and laser printers, Magnetic memory systems, Video display unit and interface logic.

7. **Introduction to Operating System**

   Processor Management, Memory Management, File Systems, Device Management.

8. A brief introduction to assembler and compiler.

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	Computer Architecture and Organization	John P. Hayes	McGraw-Hill I.E.
2.	Computer organization and Design	P. Pal Chaudhuri	PHI
3.	Computer Systems Design and Architecture	V. P. Heuring and H.F.Jordan	Addison Wesley.
4.	Computer Architecture and Parallel Processing	Kai Hwang and F.A. Briggs	McGraw-Hill I.E.

EE 1486 **EHV TRANSMISSION** **L T P C**
Open Elective II **3 0 0 6**
Electrical Engineering Branch

Prerequisites: Power System-I (EE 1205),Power System-II (EE 1303)

1. **Introduction to EHV AC Transmission**: Role of EHV AC Transmission.
2. **Calculation of line & Ground parameters:** Resistance of conductors, Temperature rise of conductor & current carrying capacity, Properties of bundled conductors, Inductance of EHV line configuration, Line Capacitance calculation, Sequence inductances & capacitances, Line parameter for modes of propagation, Resistance & Inductance of ground return.
3. **Voltage gradient of conductors**: Electrostatics, Field of sphere gap, Field of line charges & properties, Change Potential relations for multi-conductor lines, Surface voltage gradient on conductors, Gradient factors & its use, Distribution of voltage gradient of subconductors of bundle.
4. **Corona Effect - 1:** I^2R loss & corona loss, Corona loss formulas, Charge voltage diagram & corona loss, Attenuation of travelling waves due to corona loss, Audible noise generation & characteristics, Limits for audible noise, AN Measurement & Meters, Formulae for audible noise & use in design, Relation between 1∅& 3∅ AN levels, Day-night equivalent noise level.
5. **Corona effect - 2 (Radio interference):** Corona pulses, their generation & properties, Properties of pulse trains & filter response, Limits of Radio interference fields, Frequency spectrum of RI field of line.
6. **Electrostatic field of EHV lines:** Electric shock & threshold current, Effects of electrostatic field on human, animals & plants.
7. **DC Power Transmission Technology:** Introduction between, Comparison between AC & DC Transmission, Application of DC Transmission
8. **Thyristor Valves:** Introduction, Thyristor device, Thyristor valves, valve test.
9. **Analysis of HVDC converters:** Pulse number, Choice of converter configuration, Simplified analysis of Graetzckts, Converter bridge characteristics, Characteristics of twelve pulse converter, detailed analysis of converters.
10. **Converter & HVDC System Control**: Principle of DC link control, Converter control characteristics, System control Hierarchy, Firing angle control, Current & Extinction angle control, Starting& stopping of DC link, Power level controllers, higher level controllers, Telecommunication requirements.

Reference Books:

S. N.	Author	Name of Book
1.	E.W. Kimbark	E.W. Transmission Vol-1
2.	Adamson &Hingrani	D.C. Transmission
3.	D.V. Rozevig.	High Voltage Engg.

EE 1487	CONTROL SYSTEMS COMPONENTS	L T P C
	Open Elective II	3 0 0 6

Electrical Engineering Department

Prerequisite: Basic Electrical Engineering (EE 1101), Analog Electronics (EE 1203), Digital Electronics (EE 1208 Control System –I (EE 1302)

Module I: Industrial Control Devices: Switches, Relays and Contactors, Power Controlled Semiconductor, Gears
Module II: Sensors: Position sensors, angular velocity sensors, proximity sensors, load sensors, pressure sensor temperature sensors, flow sensors, level sensors, Tachometers;
Module III: Synchro, Potentiometers, Op-Amp
Module IV: DC & AC Servomotors, Stepper Motor
Module V: Pneumatic, Hydraulic, Mechanical& Electrical systems, Hydraulic and pneumatic Valves and their characteristics, Hydraulic and Pneumatic Actuators & their characteristics and Comparison.
Module VI: Implementation of PID Controller
Module VII: Microprocessor based control, PC Based Control, Dedicated customized controllers,PLC, DCS, SCADA

Reference Books:

S.N.	Author	Name of Book	Publisher
1.	Kilian	Modern Control Technology: Components and Systems	Thomson Delmar
2.	Desai	Control System Components	PHI

Course Structure for B Tech (4 Year, 8 Semester Course) Electronics and Instrumentation Engineering
(to be applicable from 2012 entry batch onwards)

Course No	Course Name	L	T	P	C		Course No	Course Name	L	T	P	C
Semester-1							**Semester-2**					
CH-1101 /PH-1101	Chemistry/Physics	3	1	0	8		EC-1101	Basic Electronics	3	0	0	6
EE-1101	Basic Electrical Engineering	3	0	0	6		CS-1101	Introduction to Computing	3	0	0	6
MA-1101	Mathematics-I	3	1	0	8		MA-1102	Mathematics-II	3	1	0	8
CE-1101	Engineering Graphics	1	0	3	5		ME-1101	Engineering Mechanics	3	1	0	8
HS-1101	Communication Skills	3	0	0	6		PH-1101/ CH-1101	Physics/Chemistry	3	1	0	8
CH-1111 /PH-1111	Chemistry/Physics laboratory	0	0	2	2		CS-1111	Computing Laboratory	0	0	2	2
ME-1111	Workshop	0	0	3	3		EE-1111	Electrical Science lab	0	0	2	2
	Physical Training-I	0	0	2	0		PH-1111/ CH-1111	Physics/Chemistry Laboratory	0	0	2	2
	NCC/NSO/NSS	0	0	2	0			Physical Training –II	0	0	2	0
								NCC/NSO/NSS	0	0	2	0
		13	**2**	**8**	**38**				**15**	**3**	**6**	**42**
Semester-3							**Semester-4**					
MA-1201	Mathematics-III	3	1	0	8		EI-1205	Transducers and Sensors	3	1	0	8
EI-1201	Circuits and Networks	3	1	0	8		EI-1206	Advanced Electronics	3	0	0	6
EI-1202	Analog Electronics	3	0	0	6		EI-1207	Control System-I	3	1	0	8
EI-1203	Electrical & Electronic Measurement & Instruments	3	1	0	8		EI-1208	Digital Electronics	3	0	0	6
EI-1204	Electromagnetic Field Theory	3	0	0	6		HS-1201	Managerial Economics	3	0	0	6
EI-1211	Circuits and Networks Lab	0	0	2	2		EI-1213	Analog and Digital Electronics Lab	0	0	2	2
EI-1212	Measurement Lab	0	0	2	2		EI-1214	Control System Lab	0	0	2	2
	Physical Training –III	0	0	2	0		EI-1215	Transducers and Sensors lab	0	0	2	2
								Physical Training-IV	0	0	2	0
	NCC/NSO/NSS	0	0	2	0			NCC/NSO/NSS	0	0	2	0
		15	**3**	**4**	**40**				**15**	**2**	**6**	**40**
Semester-5							**Semester-6**					
EI-1301	Industrial Instrumentation-I	3	0	0	6		EI-1305	Industrial Instrumentation-II	3	1	0	8
EI-1302	Process Control Engineering	3	1	0	8		EI-1306	Control System-II	3	0	0	6
EI-1303	Power and Industrial Electronics	3	0	0	6		EI-1307	Digital Signal Processing	3	0	0	6
EI-1304	Communication & Telemetry	3	1	0	8		EI-1308	Microprocessors and Microcontrollers	3	1	0	8
HS-1301	Business Management	3	0	0	6		EI-1309	Virtual Instrumentation	3	0	0	6
EI-1311	Industrial Process Engineering Lab	0	0	2	2		EI-1314	Microprocessor & Microcontrollers Lab	0	0	2	2
EI-1312	Communication Lab	0	0	2	2		EI-1315	Instrumentation lab	0	0	2	2
EI-1313	Power Electronic Lab	0	0	2	2		EI-1316	Digital Signal Processing Lab	0	0	2	2
		15	**2**	**6**	**40**				**15**	**2**	**6**	**40**
Semester-7							**Semester-8**					
EI-1401	Advanced Instrumentation	3	0	0	6		EI-1403	Real Time Embedded Systems	3	0	0	6
EI-1402	IC & VLSI Design	3	0	0	6		EI-1XXX	Dept Elective-III	3	0	0	6
EI-1XXX	Dept. Elective –I	3	0	0	6		EI-1XXX	Dept. Elective -IV	3	0	0	6
EI-1XXX	Dept. Elective –II	3	0	0	6		EI-1XXX	Dept. Elective –V	3	0	0	6
EI-XXX	Open Elective –I	3	0	0	6		XX 1XXX	Open Elective –II	3	0	0	6
EI-1411	Instrumentation and Automation lab	0	0	2	2		EI-1491	Project –II	0	0	10	10
EI-1490	Project- I	0	0	8	8				**15**	**0**	**10**	**40**
		15	**0**	**10**	**40**							

LIST OF ELECTIVES

Elective –I

EI 1421	MEMS and Nano Technology
EI 1422	Precision Instrumentation
EI 1423	Artificial Intelligence and Expert Systems
EI 1424	Robotics and Automation
EI 1425	Wireless Communication
EI 1426	Operating Systems

Elective –II

EI 1431	Intelligent and Knowledge Based Systems
EI 1432	Renewable Energy Source and Management
EI 1433	PC Based Instrumentation Systems
EI 1434	Higher Power Semiconductor Devices
EI 1435	Biomedical Instrumentation
EI 1436	Intelligent Instrumentation
EI 1437	Logic and Distributed Control Systems

Elective –III

EI 1441	Mechatronics
EI 1442	Digital Image Processing
EI 1443	Industrial Communications
EI 1444	Automotive Instrumentation And Control
EI 1445	Web Based Instrumentation
EI 1446	Optimization Techniques
EI 1447	Industrial Management

Elective -IV

EI 1451	Computer Networks
EI 1452	Biomedical Signal Processing
EI 1453	Power Plant Instrumentation
EI 1454	Mobile Communications
EI 1455	Non Linear Controls
EI 1456	Information Securities
EI 1457	VLSI Systems & Applications
EI 1458	Advanced Sensor and Signal Processing Systems

Elective –V

EI 1461	Opto-electronics and fiber Optics
EI 1462	Data base management systems
EI 1463	Data Warehousing and Data Mining
EI 1464	Petro-Chemical Instrumentation
EI 1465	Wind and Solar Energy Systems
EI 1466	Advanced Control Systems

Open Elective-I

EI 1471	Soft Computing Techniques for Non-linear Optimization
EI 1472	Smart Sensors
EI 1473	Evolutionary Algorithms in Search and Optimization
EI 1474	Modern Analytical Instruments
EI 1475	Industrial Automation
EI 1476	Mobile Adhoc and Sensor Networks

Open Elective-II

EI 1481	Optimization Methods in Engineering
EI 1482	Machine Intelligence
EI 1483	Human-Computer Interfaces
EI 1484	Micro Electro Mechanical Systems (MEMS)
EI 1485	Neural Networks and Fuzzy Logic
EI 1486	Bio-Medical Engineering
EI 1487	Industrial Piping and Instrumentation Diagrams
EI 1488	Analog Integrated Circuit Design

EI 1201	CIRCUITS AND NETWORKS	L	T	P	C
	Pre-requisite- None	3	1	0	8

Semester- 3

UNIT I : BASIC CIRCUIT CONCEPTS

Lumped circuits, circuits elements, V-I relationships of R, L and C, independent sources, dependent sources, simple resistive circuits, Kirchhoff's Laws, analysis of series and parallel circuits, network reduction, voltage division, current division, source transformation, star-delta transformation.

UNIT II : SINUSOIDAL STEADY STATE ANALYSIS

Concepts of phasor and complex impedance and admittance, analysis of simple series and parallel circuits, active power, reactive power and power factor, series resonance and parallel resonance, bandwidth and Q factor, solution of three phase balanced circuits, power measurements by two wattmeter methods, solution of three phase unbalanced circuits.

UNIT III : CIRCUITS AND THEOREMS

Analysis of complex circuits using mesh and nodal methods, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem, compensation theorem, substitution theorem, maximum power transfer theorem, Millman's theorem with applications.

UNIT IV : RESPONSE OF ELECTRIC CIRCUITS

Concept of complex frequency, pole-zero plots, frequency response of RL, RC and RLC circuits, transient response of RL, RC and RLC series and parallel circuits, free response, step and sinusoidal responses, natural frequency, damped frequency, damping factor and logarithmic decrement, response of circuits for non-sinusoidal periodic inputs.

UNIT V : TWO PORT NETWORK AND FILTERS

Driving point and transfer impedances, admittances, voltage and current ratios of two port networks, admittance, impedance, hybrid – transmission and image parameters for two port networks, impedance matching, equivalent Π and T networks, passive filters as a two port network, characteristics of ideal filter, low pass and high pass filters.

TEXT BOOKS

1. W.H. Hyatt Jr. and J.E. Kemmerly, "Engineering Circuits Analysis", McGraw-Hill International Editions.
2. M. Nahvi and J.A. Edminister, "Electric Circuits", Schaum's outline series McGraw-Hill,Fourth Edition.

REFERENCES

1. A. Sudhakar and S.P. Shyam Mohan, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, 2007.
2. M. Arumugam and N. Premkumar, "Electric circuit Theory", Khanna Publishers, 1991.
3. A. Chakrabarti, "Circuit Theory – Analysis and Synthesis", Dhanpat Rai & Co., 2001.
4. Nilsson and Riedel, "Electric Circuits", Eighth Edition, Pearson Education, 2008.

EI 1202	ANALOG ELECTRONICS	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 3

UNIT I:

Transistors Amplifier: Small Signal BJT amplifiers: AC equivalent circuit, hybrid remodel and their use in amplifier design. Analysis of single stage transistor amplifier using h-parameters: voltage gain, current gain, Input impedance and Output impedance. Comparison of transistor configurations. Multistage amplifiers.

UNIT II:

JFET characteristics (Qualitative and Quantitative discussion), Small signal model of JFET, MOSFET characteristics (Enhancement and depletion mode), Symbols of MOSFET, Comparison of Transistors, Introduction to SCR and UJT.

Power amplifiers: Class A, B, AB, C & D stages, IC output stages

UNIT III:
Basics of operational amplifiers, Characteristics of an ideal operational amplifier and its block diagram, Definition of differential voltage gain, CMMR, PSRR, slew rate and input offset current, Frequency Response, Application of operational amplifiers- first and second order filters, adder, subtractor, integrator, differentiator, Comparator, Clipper, clamper, Schmitt Trigger, Instrumentation Amplifier, Logarithmic amplifiers rectifiers.

UNIT IV:
Introduction to Active Filters, First and second order Low-Pass Butterworth filter; filter Design, Frequency Scaling, First and Second-Order High-Pass Butterworth filters, Band-Pass and Band-Stop Filters; Wide Band-Pass, Band-reject and Narrow Band-Pass, Band Reject filters, All-Pass Filters, Oscillators; Oscillator Principles, Oscillator Types, Frequency Stability, Phase shift oscillator, Wien Bridge Oscillator, Quadrature Oscillator, Square-Wave generator, Triangular-wave Generator, Saw tooth-wave generator, Voltage controlled Oscillator, timer 555.

Text Books:

1. Electronic Devices and Circuits theory, 9th/10th Edition, R.L. Boylestadand L.Nashelsky, Pearson Education, New Delhi.
2. Microelectronics Circuits, 5th Edition, International Student Edition Sedraand Smith , Oxford University Press, New Delhi.
3. Electronic Devices and Circuits, 3rd Edition, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Reference Books:

1. Electronics Circuits Analysis and Design, 3rd Edition, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Milliman's Electronics Devices and Circuits, 2nd Edition, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi.

EI 1203	ELECTRICAL & ELECTRONIC MEASUREMENT AND INSTRUMENTS	L	T	P	C
	Pre-requisite- None	**3**	**1**	**0**	**8**

Semester- 3

UNIT I: MEASUREMENT AND ERROR:
Introduction, Definition, significance of measurement, Measurement characteristics, Calibration of instruments, Static & dynamic characteristics. Types of errors, Statistical analysis, Probability of errors, Limiting error with examples.

UNIT II: ELECTRICAL MEASURING INSTRUMENTS:
Classification of instruments, Overview of PMMC, Moving iron, Dynamo Meter type instruments, Galvanometer, different types of galvanometer and it's application. Overview of Ammeter, Voltmeter & Multimeter, True rms voltmeter, Potentiometers.Extension of range of instruments- shunts & multipliers- Current transformers- Potential Transformers, Strip chart recorders.

UNIT III: A. C AND D. C BRIDGES:
General equation for bridge balance, D.C. bridges, Wheatstone bridge, Kelvin's double bridge, General form of an A.C. bridge, Maxwell's inductance –capacitance bridge, Hay's bridge, Anderson's bridge, Schering bridge, Wien's bridge, Sources of errors in bridge measurement, Wagner earthing device.

UNIT IV: MEASUREMENT OF POWER AND ENERGY:
Definitions of power, types, Measurement of power, different methods, construction and working of Electrodynamometer type of Wattmeter. Errors in power measurements. Energy, Induction type energy meter,

Indicating type Frequency meter, Electrodynamometer type P.F. meter- construction and working principle, advantages, disadvantages of all.

UNIT V: ELECTRONIC MEASURING INSTRUMENTS:

Measurement of quality factor(Q), Digital voltmeter(DVM)-Ramp type, Integrating type, ADC, Digital frequency meter, CRO, Construction, Time based circuit, Measurement with CRO,CRO probes.

UNIT VI: SIGNAL GENERATIONS AND WAVEFORM ANALYZING INSTRUMENTS:

Function generator-Square, triangular Sinusoidal waveform generator, Spectrum analyzer.

TEXT BOOKS/REFERENCES:

1. Electrical and Electronic Measurements & Instrumentation By A.K. Sawhney - Dhanpat Rai
2. Electronic Measurement & Instrumentation By H. Cooper – PHI.
3. Electronics Instruments & Measurement by David A. Bell – PHI.

EI 1204	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 3

UNIT I THE STATIC ELECTRIC FIELD

Coulomb's law, Electric field strength, Field due to point charges, a line charge and sheet charge, field due to a continuous vol. charge, Electric flux density, Gauss's law in integral form, Gauss's law in differential form (Maxwell's first equation in electrostatics), Application of Gauss's law.

Electrostatics: potential difference and potential. Potential and potential difference expressed as a line integral. The potential field of a point charge, potential field of a system of charges, conservative property, Potential gradient, the dipole, energy density in the electrostatic field.

UNIT II THE STATIC MAGNETIC FIELD

The Biot Savart's law (the magnetic field of filamentary currents), the magnetic field of distributed currents-surface and volume currents, Ampere's circuital law in integral and differential form (Maxwell's curl eqn. for steady magnetic fields), the scalar and vector magnetic potentials.

Maxell's divergence equation for B. Steady magnetic field laws. Forces in a magnetic field, force on a current element. Force between two current elements. Force and torque in a current loop.

UNIT III THE ELECTROMAGNETIC FIELD

Faraday's laws in integral and differential form (Maxwell's first curl eqn. for electromagnetic field). The Lorentz force equation, the concept of displacement current and modified Ampere's circuital law in integral and differential form. (Maxwell's 2nd curl eqn. for the electromagnetic field). The continuity equation, Power flow in an electromagnetic field-the Pointing vector. Sinusoidally time varying fields. Maxwell's eqn. for sinusoidally time varying fields. Power and energy considerations for sinusoidally time varying fields, The retarded potentials, Polarization of vector fields. Review of the Maxwell's eqns.

UNIT IV MATERIALS AND FIELDS (REVIEW TYPE ONLY)

Current and current density. The continuity eqn. conductor in fields-drift velocity, mobility, conductivity. Dielectrics in fields-Polarizations, flux density. Electric susceptibility, relative permittivity. Boundary conditions in perfect dielectrics. Magnetic materials, magnetisation, permeability and magnetic boundary conditions.

UNIT V APPLIED ELECTROMAGNETICS - I

Poisson's and Laplace's eqns. Solution of one dimensional cases. General solution of Laplace's eqn. Method of images.

UNIT VI APPLIED ELECTROMAGNETICS - II

Electromagnetic waves, The Helmhottz eqns. Radiation of electromagnetic waves. Wave motion in free pace. Wave motion in perfect dielectric. Wave motion in lossy dielectric. Propagation in good conductors : skin effect. Reflection of uniform plane waves.

TEXT BOOKS:

1. John D Kraus, 'Electromagnetics', McGraw-Hill Book Co., New York, Third Edition, 1989.
2. Joseph A Edminister, 'Theory and Problems of Electromagnetics', Schaum's Outline Series, McGraw Hill Book Company, New York, 1986.
3. William H.Hayt, Jr., 'Engineering Electromagnetics', Tata McGraw-Hill Edition, New Delhi, 1998

REFERENCES:

1. David J.Griffith, 'Introduction to Electrodynamics', Prentice Hall of India Pvt Ltd., New Delhi, Second Edition, 1997.
2. Richard E.Dubroff, S.V.Marshall, G.G.Skitek, 'Electromagnetic Concepts and Applications', Fourth Edition, Prentice Hall of India Pvt Ltd., New Delhi, 1996.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw–Hill International Editions, Fifth Edition, 1999.

		L	T	P	C
EI 1211	**CIRCUITS & NETWORKS LAB**				
	Pre-requisite- None	**0**	**0**	**2**	**2**
	Semester- 3				

List of Experiments:

1. Transient response in R-L and R-C Network: Simulation/hardware
2. Transient response in R-L-C Series & Parallel circuits Network: Simulation/hardware
3. Determination of Impedance (Z) and Admittance(Y) parameters of two port network
4. Frequency response of LP and HP filters
5. Frequency response of BP and BR filters
6. Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse,Ramp signals using MATLAB in both discrete and analog form
7. Evaluation of convolution integral, Discrete Fourier transform for periodic & non-periodic signals and simulation of difference equations using MATLAB
8. Representation of poles and zeros in z-plane, determination of partial fraction expansion in z-domain and cascade connection of second order system using MATLAB
9. Determination of Laplace transform and inverse Laplace transformation using MATLAB
10. a) Study of RC low pass filter as an integrator; b) Study of frequency response of low pass filter
11. a) Study of RC high pass filter as an differentiator
    b) Study of frequency response of high pass filter
12. Design of different clipper circuits
14. Study of different clamper circuits: positive, negative & bias
15. Design & study of Frequency response of two stage RC coupled amplifiers
16. Study of power amplifiers

		L	T	P	C
EI 1212	**MEASUREMENT LAB**				
	Pre-requisite- None	**0**	**0**	**2**	**2**
	Semester- 3				

List of Experiments (Any Fourteen expts as instructed by course coordinators)

1. Measurement of an unknown medium resistance using Wheatstone bridge.
2. Measurement of an unknown low resistance using Kelvin's double bridge.
3. Measurement of an unknown self inductance using Maxwell's inductance capacitance bridge.
4. Determination of critical damping resistance of a D'Arsonval galvanometer
5. Calibration of Ammeter, Voltmeter and Wattmeter using Potentiometer.

6. a) Design, construction and calibration of series and shunt type Ohmmeters; b) Measurement of insulation resistance of cable by Megger or Insulation tester
7. Calibration of wattmeter at different Power Factors.
8. Testing of CT & PT; Measurement of power of HV circuit using CT & PT .
9. Measurement of unknown Parameter using LCR meter(Q-meter).
10. Measurement of unknown Frequency using Frequency Counter Trainer.
11. Measurement of three-phase power by two Wattmeter Method.
12. Measurement of Phase & Frequency with CRO.
13. Magnetic measurement using Ballistic Galvanometer.
14. Measurement of R,L and C by using RLC bridge instrument.
15. Measurement of resistance by using: (i) Wheatstone bridge, (ii) Kelvin's double bridge.
16. Study of various types of multimeters and measurement of different AC, DC parameters.
17. Demonstration of MC, MI, Induction type and dynamometer type instruments.
18. Measurement of self inductance, mutual inductance and coupling coefficient of transformer windings & Air cored Coils
19. Extension of range of Ammeter, Voltmeter and Wattmeter using Shunt Series resistance and instrumentation Transformers.
20. Calibration of Single Phase energy meter by: (i) Direct Loading; (ii) Phantom Loading at various points
21. Calibration of 3 Phase energy meter using standard watt meter.
22. a) Measurement of Capacitance using Schering Bridge; b) Measurement of Frequency using Wien's bridge
23. a) Measurement of Power Factor at Consumer terminals, b) Measurement of Maximum KVA demand of a Consumer.

EI 1205	**TRANSDUCERS AND SENSORS**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**3**	**1**	**0**	**8**

Semester- 4

UNIT I

Introduction, General concepts and terminology of measurement systems, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data. Standards and Calibration. Transducers and sensors, classification, emerging fields of sensor technologies

UNIT II

Variable resistance transducers**:** Potentiometers, metal and semiconductor strain gauges and their signal conditioning circuits, strain gauge applications: Load and torque measurement. Instrumentation amplifier-circuits and applications.

UNIT III

Inductive transducers- Transformer type, synchros, eddy current transducers, proximity detectors. Tacho generators and stroboscope. Capacitive transducers, capacitive microphone.

UNIT IV

Piezoelectric transducers, charge amplifier and signal conditioning of PE transducers; photoelectric transducers, photo-voltaic cell, proximity sensors, Hall effect sensors, Magnetostrictive transducers, Basics of Gyroscope, Seismic instrument and accelerometers.

UNIT V

Thermocouples: Thermoelectric effects, laws of thermocouple, cold junction compensation techniques, thermocouple types, construction, measuring circuits, thermocouple burn out detection and high temperature measurement methods.

Temperature measurement: Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. Thermistors, principle and sensor types, measuring circuits, linearization methods and applications. Digital displacement sensors, Semiconductor sensor.

Text Books:

1. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi.
2. Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd.
3. Doebelin E.O, "Measurement Systems - Application and Design", 4th Edition, McGraw-Hill, New York, 2003.

Reference Books:

1. Neubert H.K.P, "Instrument Transducers - An Introduction to their Performance and Design", 2nd Edition, Oxford University Press, Cambridge.
2. Waldemar Nawrocki, "Measurement Systems and Sensors", Artech House.
3. S.M. Sze, "Semiconductor sensors", John Wiley & Sons Inc., Singapore.
4. B. C. Nakara & Chaudhry, "Instrumentation Measurement and Analysis", TATA McGraw-Hill, New Delhi.

EI 1206	ADVANCED ELECTRONICS	L	T	P	C
	Pre-requisite- None	**3**	**0**	**0**	6

Semester- 4

UNIT I: TRANSISTOR AT HIGH FREQUENCIES

Hybrid –pi CE Transistor Model, Hybrid –pi Conductance, Hybrid –pi Capacitances, Validity of Hybrid –pi Model, Variation of Hybrid –pi Parameters, CE Short-Circuit Current Gain, Current Gain with Resistive Load, Single-Stage CE Transistor Amplifier Response, Gain-Bandwidth Product, Emitter Follower at High Frequencies.

UNIT II: MULTISTAGE AMPLIFIERS

Classification of Amplifiers, Distortion in Amplifiers, Frequency Response of an Amplifier, Bode Plots, Step Response of an Amplifier, Cascaded Stages, RC Coupled Amplifier, Low Frequency Response of an RC Coupled Stage, Effect of an Emitter Bypass Capacitor on Low- Frequency Response, High-Frequency Response of Two Cascaded CE Transistor Stages, Multistage CE Amplifier Cascade at High Frequencies

UNIT III: FEEDBACK AMPLIFIERS

Classification of Amplifiers, Feedback Concept, Transfer Gain with Feedback, General Characteristics of Negative Feedback Amplifiers, Input Resistance, Output Resistance, Method of Analysis of a Feedback Amplifier, Voltage Series Feedback, A Voltage Series Feedback Pair, Current Series Feedback, Current Shunt Feedback, Voltage Shunt Feedback

UNIT IV: STABILITY AND OSCILLATORS

Effect of Feedback on Amplifier Bandwidth, Double-Pole Transfer Function with Feedback, Three –Pole Transfer Function with Feedback, Approximate Analysis of a Multi pole Feedback Amplifier, Stability, Gain and Phase Margins, Compensation, Dominant-Pole Compensation, Pole-Zero Compensation, Compensation by Modification of the Network, Sinusoidal Oscillators, Phase-Shift Oscillator, Resonant Circuit Oscillators, A General Form of Oscillator Circuit, Wien Bridge Oscillator, Crystal Oscillators, Frequency Stability

UNIT V: OPERATIONAL AMPLIFIERS

Review of Operational Amplifiers and applications/operations. An Example of an IC Operational Amplifier, Offset Error Voltages and Currents, Temperature Drift of Input Offset Voltage and Current, Measurement of Operational Amplifier Parameters, Frequency Response of Operational Amplifiers, Dominant –Pole Compensation, Pole-Zero Compensation, Lead Compensation, Step Response of Operational Amplifiers

UNIT VI: LOGIC FAMILIES

Diode Transistor Logic, High Threshold Logic, Transistor Logic, Resistor Transistor Logic, Direct Coupled Transistor Logic, Comparison of Logic families

UNIT VII: ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

Digital to Analog Conversion, R-2R ladder type DAC, Weighted resistor type DAC, Switched current source type

DAC, Switched capacitor type DAC, Analog to Digital Conversion, Counter type A/D converter, , Flash type A/D converter, Dual slope A/D converter, Successive approximation ADC.

Text Books:

1. Millman and Halkias. C., "Integrated Electronics", Tata McGraw-Hill.
2. Schilling and Belove, "Electronic Circuits", TMH, Third Edition.
3. Millman J. and Taub H., "Pulse Digital and Switching waveform", McGraw-Hill International .
4. Robert L. Boylestead and Louis Nasheresky, 8th edn., PHI.

REFERENCES:

1. Sedra Smith, "Micro Electronic Circuits" Oxford university Press.
2. David A. Bell, " Solid State Pulse Circuits ", Prentice Hall of India.

EI 1207	CONTROL SYSTEM-I	L	T	P	C
	Pre-requisite- None	3	1	0	8
	Semester- 4				

UNIT I: Definition of System – linear Vs non-linear, time variant Vs time invariant, causal Vs non-causal, lumped Vs distributed. Definition of Control system, automatic control, manual control, open loop, closed loop, feedback loops, Components in a closed loop control system, servo control, regulatory control. Variables and parameters. Review of ordinary differential equations, Laplace transformation.

UNIT II: Fundamental laws, Conservation principle, modeling of electrical – RLC circuits, servo motors, stepper motors, mechanical – MBK system, fluid – liquid level, pneumatic, hydraulic and thermal systems, electro-mechanical systems. Translational, rotational systems and their electrical analogy. Transfer function, properties of transfer function. Block diagram reduction, Signal flow graph, Mason's gain formula. Effect of feedback on stability, overall gain, sensitivity, parameter variation. Linear approximation of physical systems.

UNIT III: Typical test signals, Transient analysis of first order systems, Transient analysis of second order systems, overshoot, damping, settling time and rise time, Analysis of multi-order control system with dominant poles, Pole-zero concepts, effect of pole location on performance specification, Type number, Steady state error analysis, error co-efficients, generalized error series, Transient analysis with derivative control, integral control and proportional control, rate feedback control. Concept of stability, relative stability analysis, Routh-Hurwitz stability criteria.

UNIT IV: Concept of stability, relative stability analysis, Routh-Hurwitz stability criteria. Basic conditions for root loci, rules for construction, stability and conditional stability on root locus.

UNIT V: Bodes plot, frequency domain behavior of a system, gain margin and phase margin, stability criteria, Polar plot, Nyquist plot and stability criteria, M&N circles, Nichol's chart. Necessity of compensations, compensation networks, design and application of lead, lag, lag-lead compensators.

UNIT VI: Limitation of Conventional Control Theory, Concepts of state variable and state model, state model for linear time invariant systems. State space representation of dynamic systems, physical notion of system state, block diagram representations, State space representation of transfer function, Transformation of state variables, Eigen values.

Text Book:

1. K Ogata, Modern Control Engineering, PHI.
2. M. Gopal, Principles and Design, Tata McGraw Hill

Reference Books:

1. I J Nagrath and M Gopal, Control system engineering; New Age International Publisher.
2. R C Dorf and R H Bishop, Modern Control Systems; Pearson Education.
3. R T Stefani, B Shahiana, C J Savant and G H Hostetter, Design of Feedback control System, Oxford University Press
4. B C Kuo, Automatic Control System; PHI.
5. D Roy Choudhury, Modern Control Engineering, PHI.

EI 1208	DIGITAL ELECTRONICS	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 4

UNIT I : BOOLEAN ALGEBRA

Review of Number Systems – Fixed point and floating point representations – Review of computer codes - Number complements - Signed number addition and subtraction - Boolean Algebra -Demorgan‟s theorem - Canonical forms -Simplification of Boolean functions using K-maps and Quine Mclusky methods.

UNIT II : COMBINATIONAL LOGIC DESIGN

Gates - Universal set of modules - Standard combinational modules - Decoders -Encoders – Multiplexers - Demultiplexers – Comparators - Code Converters -Function realization using Gates and Multiplexers – Adders - Carry Look Ahead Adder - Subtraction using adders - BCD adder.

UNIT III : SEQUENTIAL LOGIC DESIGN

Basic latch circuit - Flip-flops - Truth table – Excitation table - Analysis and design of synchronous sequential circuits - Transition table - Transition diagram – Introduction to asynchronous sequential circuits - Race in sequential circuits - Hazards -Techniques for controlling hazards.

UNIT IV : COUNTERS AND SHIFT REGISTERS

Asynchronous Counter design and Synchronous Counter design - Up/Down counter -Modulus counter - Shift Registers - Johnson Counter – Ring Counter -Application of Counters and Shift Registers.

UNIT V : INTRODUCTION TO LOGIC FAMILIES

Introduction to logic families: - RTL, DTL, ECL, TTL, NMOS, CMOS - GaAs Building blocks - Operating conditions –Interfacing between different families.

TEXT BOOKS:

1. Morris Mano, M., “Digital Design”, Prentice Hall, 2006.
2. A Malvino and D Leach, “Digital Principles and Applications”, Tata McGraw. Hill, 2002.
3. J.P. Uyemura, “A First Course in Digital Systems Design”, Brooks/Cole Publishing Co.

REFERENCES:

1. Tocci, R.J., “Digital systems: Principles and Applications”, Prentice Hall, 8th Edition, 2005.
2. Taub and Schilling, “Digital Integrated Electronics”, Tata McGraw Hill.
3. Floyd and Jain, “Digital Fundamentals”, Pearson Education.

EI 1213	ANALOG & DIGITAL ELECTRONICS LAB	L	T	P	C
	Pre-requisite- None	0	0	2	2

Semester- 4

LIST OF EXPERIMENTS

1. Design and implementation of Adders and Subtractors using logic gates.
2. Design and implementation of code converters using logic gates.
3. BCD to excess-3 code conversion and vice-versa.
4. Binary to gray code conversion and vice-versa.
5. Design and implementation of Multiplexer and De-multiplexer using logic gates and study of IC74150 and IC74154.
6. Design and implementation of encoder and decoder using logic gates and study of IC74145 and IC74147.
7. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip-flops.
8. To study S-R, J-K, D & T Flip-flops
9. To study synchronous, asynchronous counter.
10. To study MOD counter, decade counter.
11. Active low-pass and band-pass filter.
12. Design of Astable and Monostable multivibrators.

13. To study the CE and CB Characteristics and find input and output impedance;
14. To study the JKFET Characteristics;
15. a) Differential amplifiers, b) Integrator and Differentiator.
16. Instrumentation amplifier.
17. To implement the Operational Amplifier as a) Comparator, b) Summer and c) Subtractor;
18. To implement the Operational Amplifier as a Schmitt Trigger;
19. To study the Monostable multivibrator using IC 555 timer;
20. To study the astable multivibrator using IC 555 timer;
21. To implement a voltage regulatory circuit using Zener Diode;
22. To study the Biasing Techniques.
22. Design of bistable multivibrators, design of Schmitt trigger.
23. Design of Wein bridge oscillator using BJT.
24. Design of RC phase shift oscillators using BJT/ FET.
25. Design of Collpitt‟s oscillators using BJT, Design of Hartly oscillators using BJT
26. Study of Frequency response of Common Source(CS) amplifier
27. To study different VI using NI Basic Electronics modules.

EI 1214	**CONTROL SYSTEM LAB**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**0**	**0**	**2**	**2**

Semester- 4

LIST OF EXPERIMENTS

1. Study of first order and second order system responses-measurement of system parameters
2. Check the stability of a system. Report whether the system is stable, unstable, or marginally stable. Given the transfer function of the system.
3. Obtaining the closed loop transfer function of a complex block diagram
4. Obtaining response of a system for an arbitrary input
5. State variable analysis-controllability, observability
6. Design of state feedback
7. Design of observer
8. Simulation of Mass Spring Dashpot system, DC Motor Control
9. Use of MATLAB for simulating transfer functions, closed loop systems etc
10. Transfer function of Field controlled DC Motor.
11. Transfer function of Armature controlled DC Motor.
12. Introduction to Control system tool box.
13. Plotting of pole-zero configuration in s-plane for the given transfer function.
14. Determining the transfer function for given closed loop system in block diagram representation.
15. Plotting unit step response of given transfer function and find peak overshoot, peak time.
16. Plotting unit step response and finding rise time and delay time.
17. Finding state space representation of given closed loop system.
18. Plotting locus of given transfer function, locating closed loop poles for different value of k.
19. Plotting root locus of given transfer function and finding S, Wd, Wn at given root.
20. Plotting Bode plot of given transfer function.
21. Plotting Bode plot of given transfer function and finding gain and phase margin.
22. Plotting Nyquist plot for given transfer function and to compare their stability.
23. Plotting Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.
24. Solving the above problems(as asked by course coordinator) using LABVIEW.

EI 1215	TRANSDUCERS & SENSORS LAB	L	T	P	C
	Pre-requisite- None	0	0	2	2

Semester- 4

LIST OF EXPERIMENTS

1. To study the strain gauge characteristics.
2. To study the characteristics and weight measurement by load cell
3. To study the construction of LVDT and its use in displacement and thickness measurement.
4. To study the flow measurement by differential pressure type transducer.
5. To study the characteristics of LDR, thermostat and thermocouples.
6. To study the testing and calibration of T, J, K ,R and S thermocouples.
7. To study the voltage – intensity characteristics of a photo – transistor
8. To study the ramp response characteristics of filled in system thermometer.
9. To study step response of RTD and thermocouple.
10. To study force and torque transducers and the working details of electrical pressure probes
11. To study the characteristics of photoelectric tachometer.
13. To study Hal Effect Transducer.
14. To study the characteristics of Accelerometer Model.
15. To study the characteristics of Angular potentiometer transducer model.
16. To design LabVIEW VI for measurement of voltage, current and PQ.
17. Measurement of temp, depth etc by optical fibre sensor.
18. To study the characteristics of Piezoelectric sensors.
19. To study the operation of sensor and actuator modules.
20. To study the operation of DAQ system for application with sensor signals.
21. Data acquisition and storage of signals through serial/parallel port (or sound card) to PC
22. PC based data acquisition using add-on (PCI) card: analog/digital inputs

EI-1301	INDUSTRIAL INSTRUMENTATION-I	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 5

UNIT – I : INDUSTRIAL MEASUREMENTS

Measurement of straightness, flatness, roundness and roughness. Electric balance – different types of load cells

– elastics load cell-strain gauge load cell- different methods of torque measurement, using strain gauge, relative regular twist-speed measurement – revaluation counter-capacitive tacho-drag up type tacho D.C and A.C tacho generators – stroboscopic methods.

UNIT – II : TEMPERATURE MEASUREMENT

Introduction - Definitions and standards – primary and secondary fixed points – Temperature scale – calibration of thermometers – different types of filled in system thermometer – sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement – signal conditioning of industrial RTDs and their characteristics – 3 lead and 4 lead RTDs – Improved bridge circuits.

UNIT – III : TEMPERATURE MEASUREMENT- APPLICATIONS

Thermocouples – law of thermocouple – fabrication of industrial thermocouples – signal conditioning of thermocouple output – thermal block references functions – commercial circuits for cold junction compensation – response of thermocouple – Linearization of thermocouple and Thermistors – colour coding Testing and calibration and Installation procedures. Special techniques for measuring high temperature using thermocouples

– Radiation methods of temperature measurement – radiation fundamentals – total radiation and selective radiation pyrometers – optical pyrometer – two colour radiation pyrometer.

UNIT – IV : MISCELLINEOUS MEASUREMENTS-I

Accelerometers - LVDT, piezo-electric, strain gauge and variable reluctance type accelerometers – mechanical type

vibration instruments – seismic instrument as an accelerometer and vibrometer – calibration of vibration pick ups – units of density, specific gravity and viscosity used in industries – Baume scale API scale – pressure head type densitometer – float type densitometer – ultrasonic densitometer Bridge type gas densitometer.

UNIT – V : MISCELLINEOUS MEASUREMENTS-II

Viscosity terms – saybolt viscometer –rotameter type viscometer – industrial consistency meters – humidity terms – dry and wetbulb psychrometers – hot wire electrode type hygrometer – dew cell – electrolysis type hygrometer – commercial type dew point meter – moisture terms - different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material.

TEXT BOOKS:

1. Ernest O.Doebelin, "Measurement systems Application and Design",International Students Edition, IV Edition, McGraw Hill Book Company.
2. R.K.Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi.
3. S.K.Singh Industrial instrumentation & control, TMH.
4. Industrial instrumentation, by K.Krishnaswamy and S.vijayachitra , new age international.
5. "Measurement Systems: Application and Design", by E.O. Doebelin, 4th Edition, McGraw Hill, New York

REFERENCES:

1. D.Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Publishing Ltd., New Delhi.
2. A.K.Sawhney, "A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Sons, New Delhi.
3. P.Holman, "Experimental Methods for Engineers", International Student Edition, McGraw Hill Book Company.
4. Liptak B.G, "Process Measurement and Analysis", 4th Edition, Chilton Book Company, Radnor, Pennsylvania.
5. Douglas M. Considine, "Process / Industrial Instruments & Controls Handbook", 5th Edition, McGraw Hill, Singapore.
6. Andrew W.G, "Applied Instrumentation in Process Industries – A survey", Vol I & Vol II, Gulf.

EI-1302	**PROCESS CONTROL ENGINEERING**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**3**	**1**	**0**	**8**
	Semester- 5				

UNIT I: CONTROL RELEVANT PROCESS MODELING AND IDENTIFICATION

Introduction to mathematical modeling. Conservation principles. Thermodynamic principles of process systems. Development of steady state and dynamic lumped and distributed parameter models based on first principles. Mathematical modeling of electrical RLC circuit, mercury thermometer, liquid level, mixing process, distillation column, and heat exchanger. Solution strategies for lumped parameter models (ordinary differential equations). Solution methods for initial value and boundary value problems, Euler"s method, R-K method, Finite difference methods. FOPTD and SOPTD model from step response analysis. Linear least square estimation. Solving the problems using *MATLAB/SCILAB.*

UNIT II: PROCESS ANALYSIS

Closed and open loop response. Review of first and higher order systems. Interacting and non-interacting systems. Stability – time domain and frequency domain analysis. Steady state and dynamic response analysis of electrical RLC circuits, Mercury Thermometer, Liquid level, Mixing processes for various standard inputs. Study of system response based on Poles – Zeros . Inverse response system. Transporation Lag.

UNIT III: INTRODUCTION TO PROCESS CONTROL

Terms and objectives. Process variables. Degree of freedom. Continuous and batch process. Servo and regulatory process. Basic elements of process control. Signal conversion - I/P converters, P/I converters. Pneumatic, electric and hydraulic actuators. Valve positioner. Effective valve characteristics - Linear, Equal percentage, Quick opening valve. Globe, Butterfly, Diaphragm, Ball valves. Valve sizing. Cavitation. Flashing. Piping and instrumentation diagram.

UNIT IV: CONTROL ACTIONS AND CONTROLLER TUNING

Basic control actions – Characteristics of two position, Multi position, Floating, P, I, D Control modes. Composite control modes – PI, PD, PID control modes. Integral windup. Selection of control mode for different processes – level, flow, pressure and temperature. Pneumatic and electronic controllers to realize various control actions. Performance criteria – IAE, ISE, ITAE, ITSE. Zeigler – Nichols tuning method, Cohen – Coon tuning method.

UNIT V: VARIOUS CONTROL TECHNIQUES

Cascade control. Ratio control. Feed forward control. Over ride control. Split range control. Selective control. Adaptive control. Inferential control. Internal model control. Multivariable control - Interaction, examples of storage tanks. Case studies : Boiler control – drum level control, combustion control. Distillation column control.

Text Books:

1. Process Control - K. Krishnaswamy; New Age International Publishers.
2. Smith C.L and Corripio.A..B, "Principles and Practice of Automatic Process Control", 2nd Edition, John Wiley and Sons, New York, 1998.
3. Shinskey, "Process Control Systems", 4th Edition, McGraw Hill, Singapore, 1996.

Reference Books:

1. Process Dynamics, Modeling and Control - Babatunde A. Ogunnaike, W. Harmon Ray; Oxford University Press.
2. Process Systems Analysis and Control - Donald R. Coughanowr; McGraw-Hill Publications.
3. Process Modeling Simulation and Control for Chemical Engineers - William L. Luyben; McGraw-Hill Publications.
4. Process Dynamics and Control : Modeling for Control and Prediction - Brian Roffel; Ben Betlem; John Wiley & Sons Ltd

EI-1303	POWER & INDUSTRIAL ELECTRONICS	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 5

UNIT I: POWER DEVICES

Power diode, Power transistor, Power MOSFET–SCR–TRIAC–GTO–IGBT–MCT– Protection of power devices. Thyristor – characteristics, application, Thyristor converters and systems, Thyristor protection.

UNIT II: CONVERTERS

Half wave, full wave and bridge rectifiers, Single phase and three phase – half controlled and fully controlled converters, Dual converters, Introduction to cycloconverters, Three – phase half-wave cycloconverters, AC controllers, Single phase voltage controllers.

UNIT III: INVERTER AND CHOPPER

Single phase voltage source inverters, Three phase bridge inverters, Voltage control in single-phase inverters, PWM inverters, Reduction of harmonics in the inverter output voltage, Current source inverters.

Principle of chopper operation, Control strategies, Types of chopper circuits, Step-up and step down chopper, Chopper classification–Class A, B, C, D, E. Steady state time-domain analysis of type-A chopper, AC and Multiphase chopper.

UNIT IV: DC AND AC DRIVES

Steady state characteristic of dc motors, Control of DC motor using converter sand choppers, Regenerative and dynamic braking, Closed loop control scheme, Speed-torque characteristic of induction motor, Static stator voltage control, V/f control, Static rotor resistance control, Slip power recovery scheme, Self control of synchronous motor.

UNIT V: APPLICATIONS

Power supply applications: Switching power supplies, Power conditioners, Uninterrupted power supplies; Other applications: Application in residential and industrial systems (Electronic choke, Automatic heater, washing machine, Air conditioners), Electric utility, Step motor drive.

Text Books:
1. Power Electronics: Circuits ,Devices and Applications by M H Rashid, Pearson.
2. Power Converter Circuits by W Shepherd and L Zhang, CRC, Taylor and Francis, Special Indian Edition.

Reference Books:
1. Power Electronics: Principles and Applications by J. Vithayathil, TMH Edition
2. Power Electronics: Converters , Applications, and Design by Mohan, Undeland and Robbins,

EI-1304	COMMUNICATION & TELEMETRY	L	T	P	C
	Pre-requisite- None	3	1	0	8

Semester- 5

UNIT I : INTRODUCTION
Representation of signals and systems in a communication system: Discrete and continuous spectra of signals, concepts of modulation and frequency translation.

UNIT : II CONTINUOUS WAVE MODULATION
Continuous wave (CW) modulation: AM, DSB/SC, SSB, VSB, methods of generation, Demodulation.
Nonlinear modulation techniques: FM and PM, narrowband FM, wideband FM, methods of generation; FM spectrum; Demodulation techniques for FM; Frequency Division Multiplexing (FDM).

UNIT III : SAMPLING & PULSE MODULATION
Sampling a signal by periodic pulse stream: spectra of ideally sampled signal, Nyquist sampling theorem, flat-top sampling, sampling of bandpass signals, examples of sampling circuits;
PAM, PWM, PPM, PFM spectra, generation and demodulation schemes.

UNIT IV : DIGITAL COMMUNICATION
Digital signals and their spectra. Information and entropy; Source coding, Quantization of signals. PCM, DPCM, ADPCM, DM, ADM. Baseband transmission: intersymbol interference, noise, eye pattern. Digital modulation schemes: ASK, PSK, FSK, DPSK; M-ary modulation schemes: QPSK, MSK; QAM.

UNIT V: TELEMETRY
Introduction, definition, classifications of telemetering systems, Purpose of telemetry, basic schemes, voltage, current and frequency telemetry, line length limitations. Concepts of Information transfer, bits, symbols, codes - source, line, channel, BCD,ABCII, BAUDOT, AMI, CMI, Manchester, HDBM, Block, Differential, Hamming, Conduction. Review of modulation and multiplexing: FM-AM, FM-FM, PAM-AM, PAM-FM, PCM-AM, etc. Quantization and conversion methods, error in quantization, bandwidth consideration
Fiber optic Telemetry- The Fibre cable-principle-Interconnections-Repeaters-Sources-transmitter & receiver circuits-WDM.

TEXT BOOKS:

1. Communication System Engineering John G. Proakis, M. Salehi, PHI
2. Principles of Communication System, Taub and Schilling, McGraw Hill I.E.
3. Communication Systems, Simon Hykin, M. Moher Wiley

REFERENCE BOOKS:

1. Telemetry principles, D. Patranabis TMH
2. Handbook of Telemetry and Remote control E. L. Gruenberg Mc Graw Hill

EI 1311	INDUSTRIAL PROCESS ENGINEERING LAB	L	T	P	C
	Pre-requisite- None	0	0	2	2

Semester- 5

LIST OF EXPERIMENTS

1. Study of first order system response – Mercury Thermometer
2. Study of second order system response – U -tube manometer

3. Study of Flapper-nozzle system
4. Study of Valve characteristics – Linear, Quick opening, Equal percentage
5. Controller tuning for various process models in SIMULINK – using Ziegler-Nichols rule
6. Controller tuning for process models in SIMULINK – using Cohen and Coon rule
7. Flow control using ON-OFF controller with and without neutral zone
8. Temperature control using P, PI, PD, and PID controllers–Study of output response
9. Flow control using P, PI, PD, and PID controllers–Study of output response
10. Liquid level control using P, PI, PD, and PID controllers–Study of output response
11. Pressure control using P, PI, PD, and PID controllers–Study of output response
12. Study of feed-forward, cascade, and ratio controls
13. Study of PLC-ladder diagram implementation for simple processes
14. Development of VI for level measurement-with display, and visual and sound alarms
15. PC based control of robotic arm
16. Study of inverted pendulum
17. Study of Industrial Process Control System using Process Control Trainer.
18. Study of Distributed Control System.
19. To measure the abnormalities (Tachycardia, Brody-cardio) present in cardiovascular system.
20. Study of signal conditioning for different sensors(LVDT, SG, Piezoelectric, Thermocouple, RTD etc).
21. Data acquisition using NI Elvis and Sensors.
22. To study with Sensors & Actuators Module for different signals/parameters.
23. Measurement & detection of displacement, pressure, motion, vibration using sensors.

EI 1312	**COMMUNICATION LAB**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**0**	**0**	**2**	**2**

Semester- 5

LIST OF EXPERIMENTS

1. To study the frequency modulation.
2. To study the sample and hold circuit.
3. Hardware realization of ASK modulator and demodulator.
4. Fourier Transform Approximation, More General PAM.
5. Sampling, Nyquist, Eye Diagrams, PR Signaling.
6. Power Spectral Density, Noise, and Symbol Timing Information.
7. PAM Receiver with Matched Filter and Symbol Timing Extraction.
8. Symbol Error Probability, Convolutional Codes, and Viterbi Algorithm.
9. Amplitude Modulation with Suppressed Carrier.
10. AM-DSB-TC, Non-Coherent Receivers, FDM.
11. M-ary Amplitude and Frequency Shift Keying, Signal Space.
12. Real Bandpass and Complex Lowpass Signals, QAM, General BPFs.
13. Phase and Hybrid Amplitude/Phase Shift Keying, Carrier Sync.
14. RF Oscillators; Second Order Filters.
15. AM Modulators & AM Demodulators
16. DSB-SC and SSB Modulators & DSB-SC and SSB Demodulators
17. FM Modulators & FM Demodulators
18. PWM Modulators & PWM Demodulators.

EI-1313	**POWER ELECTRONIC LAB**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**0**	**0**	**2**	**2**

Semester- 5

LIST OF EXPERIMENTS

1. SCR characteristics
2. Triac and Diac characteristics
3. Phase controlled rectifier-resistance triggering
4. Phase controlled rectifier- UJT triggering

5. Chopper circuits, D.C. Jones Chopper
6. Single Phase cycloconverter.
7. Single phase dual converter.
8. MOSFET characteristics
9. Simple DC to AC inverter circuit
10. Driven DC to AC inverter using MOSFET & IC
11. IGBT characteristics
12. Inverter circuit using IGBT
13. Digital triggering circuit for phase controlled rectifiers
14. Application of ICS: PWM IC TL 494, optocoupler IC -MCT2E
15. DC motor speed control – Using digital logic circuits/microprocessor/PC
16. AC motor speed control – Using digital logic circuits/microprocessor/PC
17. Simulation of power electronic converter and inverter circuits using software like MATLAB, PSPICE

EI 1305	INDUSTRIAL INSTRUMENTATION-II	L	T	P	C
	Pre-requisite- None ,Semester: 6	3	1	0	8

UNIT-1 LEVEL MEASUREMENT

Gauge glass technique coupled with photo electric readout system – float type level indication- different schemes- – level switches level measurement using displacer and torque tube – bubbler system. Boiler drum level measurement – ifferential pressure method – hydra step systems – electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors.

UNIT II : PRESSURE MEASUREMENT

Units of pressure – Types of pressure-Non-Electric type pressure measurement – manometers – different types – elastic type pressure gauges – Motion and force balance designs. Bourdon type bellows – diaphragms – Electrical methods – elastic elements with LVDT and strain gauges – capacitive type pressure gauge – piezo resistive pressure sensor – resonator pressure sensor – measurement of vacuum – McLeod gauge – Knudsen gauge – thermal conductivity gauges – Ionization gauge cold cathode and hot cathode types – Electrical pressure transmitter – testing and calibration of pressure gauges – dead weight tester.

UNIT III :FLOW MEASUREMENT - MECHANICAL TYPE FLOWMETERS

Theory of fixed restriction variable head type flow meters-orifice plate – venturi tube – flow nozzle – dall tube – installation of head flow meters- piping arrangement for different fluids – pilot tube. Positive displacement flow meters – constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters-inferential meter turbine flow meter – rotameter – theory and installation – angular momentum mass flow meter – coriolis mass flow meters – thermal mass flow meter – volume flow meter plus density measurement – calibration of flow meters – dynamic weighing method.

UNIT – IV :FLOW MEASUREMENT - ELECTRICAL TYPE FLOWMETERS

Electrical type flow meter: Principle and constructional details of electromagnetic flow meter – different types of excitation – schemes used – different types of ultrasonic flow meters-laser Doppler anemometer systems – vortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter.

UNIT V: INDUSTRIAL SAFETY AND SPECIFICATIONS

Safety: Introduction, electrical hazards, hazardous areas and classification, Non hazardous areas, enclosures – NEMA types, fuses and circuit breakers, protection methods: purging, explosion proofing and Intrinsic safety. Specification of instruments, preparation of project documentation, process flow sheet, Instrument index sheet, Instrument specification sheet, panel drawing and specifications.

TEXT BOOKS:

1. R.K.Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi.
2. C. D. Johnson, “Process Control Instrumentation Technology”, PHI
3. S.K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill Publishing Ltd., New Delhi

REFERENCE BOOKS:

1. D.Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Publishing Ltd., New Delhi,
2. Andrew W.G, "Applied Instrumentation in Process Industries – A survey", Vol. 1 & Vol.2, Gulf Publishing Company, Houston.
3. Ernest O.Doebelin, "Measurement systems Application and Design", International Student Edition, IV Edition,McGraw Hill Book Company.

EI 1306	CONTROL SYSTEM-II	L	T	P	C
	Pre-requisite- EI 1207	3	0	0	6

Semester- 6

UNIT I: Review of transfer function and state space methods, time domain solution of state equations, state transition matrix, interpretation and properties of the state transition matrix, state space representation of MIMO systems, stability of systems in state space. State space modeling of systems: Inverted pendulum on a cart, two capacitance system, spring coupled masses, distillation column, instrument servo, missile guidance dynamics (any four).

UNIT II: Linear algebra, vector spaces, span and change of basis, Cayley - Hamilton theorem, QR decomposition. Singular value decomposition, Computation of state transition matrix.

UNIT III: Definition and test of controllability, observability, detectability and stabilizability. Effect of pole - zero cancellation. State feedback control for controllable canonical form, State feedback control in general, Output feedback controller. Full-order and reduced-order observers, Introduction to Linear Quadratic problems.

UNIT IV: Introduction to Discrete time systems , analogies with continuous-time systems, mathematical models for LTI discrete- time systems, Z- transformation of difference equation, analysis of first, second order and higher order systems, Stability analysis in Z – domain. State space modeling of discrete-time dynamical systems.

UNIT V: Non-linear system analysis: Non-linear system behavior, different methods of linearization, Lyapnov stability criterion. Phase plane analysis, singular points, constructing phase portraits, existence of limit cycle, stability of limit cycles, describing functions.

TEXT BOOKS:

1. K Ogata, Modern Control Engineering, Prentice Hall Inc., New Jersey.
2. Brogan W. L, Modern Control theory, Prentice Hall International, New Jersey.

REFERENCE BOOKS:

1. Jean-Jacques E. Slotine, Weiping Li, Applied nonlinear control, Prentice Hall Inc., New Jersey.
2. Skelton R. E, Dynamic System Control and Linear System Analysis and Synthesis, John Wiley and Sons Inc., New Delhi.
3. Vidyasagar .M, Nonlinear system analysis, Second Edition, Prentice Hall Inc., New Jersey.

EI-1307	DIGITAL SIGNAL PROCESSING	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 6

UNIT I : INTRODUCTION

Review of different discrete time signals, analysis of different LTI systems, Fourier transforms, Z- transforms, properties of Z-transform, sampling theorem, application of Z-transform in transient A.C signal filtering.

UNIT II : STRUCTURES OF DISCRETE-TIME SYSTEMS

Block diagram representation of linear constant coefficient difference equations-their interconnection schemes; direct form-I, direct form-II, cascade form and parallel form structures, Finite precision word-length effect-number representation , analysis of effect of coefficient quantization and rounding of noise, zero input limit cycles in fixed-point realizations of IIR digital filters.

UNIT III : FILTER DESIGN TECHNIQUES

Characteristics of practical frequency selective filter, design of FIR filters by windowing, characteristics of Butterworth And Chebyshev filters, design of IIR filters from continuous-time filters-Impulse invariance and bilinear transformation methods.

UNIT IV : DISCRETE FOURIER TRANSFORMS

Frequency domain sampling, the DFT and properties of DFT, circular convolution, linear convolution using DFT, DFT Application in A.C, transient signal analysis.

UNIT V: EFFICIENT COMPUTATION OF DFT

Computational complexity, FFT algorithm – the decimation-in-time and decimation-in-frequency, signal flow graph Butterfly computation, in-place computations, analysis of computational complexity

UNIT VI : MULTIRATE DIGITAL SIGNAL PROCESSING

Introduction to multirate digital signal processing, sampling rate conversion, filter structures, multistage decimator and interpolators, digital filter banks

UNIT VII : APPLICATIONS: Dual-tone multi-frequency signal detection, spectral analysis using DFT, music sound processing, digital FM stereo generation etc. Feature extraction of signals and different methods (e.g. feature extraction of power qualities in electrical supply or distribution system, or EEG in BCI system, etc)

TEXT BOOKS:

1. Digital Signal Processing : Proakis and Manolakis

REFERENCE BOOKS:

1. Digital Signal Processing, Mitra, PHI.
2. Discrete-time Signal Processing, Oppenheim and Schafer.

EI 1308	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
	Pre-requisite- None	**3**	**1**	**0**	8

Semester- 6

MODULE I:

Architecture:

General 8-bit microprocessor and its architecture ,8085 functional block diagram ,architecture functions of different sections.

Instruction Sets:

Instruction format,addressing addressing modes , instruction set of 8085 CPU , instruction cycle , timing diagrams , different machine cycles , fetch and execute operations , estimation of execution time.

Assembly Language Programming

Assembly format of 8085 , assembly directions ,multiple precision arithmetic operations,binary to BCD and BCD to binary code conversion ,ALU programming using look up table , stack and subroutines.

MODULE II:

Intel 8086/8088 Microprocessor: Architecture, Clock Generator, Resetting the microprocessor, Wait State Inserting, Bus Buffering, Interrupts, and Assembly Language Programming and Addressing Modes.

MODULE III:

Interfacing Memory: Classification of Memory, Address decoding (using logic gates, decoders and PAL), Interfacing Static RAM Interfacing EPROM ,Designing Memory Modules (higher capacity say 512K) using memory chips.Interfacing I/O Devices.

MODULE IV:

Interfacing and assembly language monitor program for Key Board (one dimensional, two dimensional) and Seven-segment display, Stepper Motor through 8255A, Data transfer between two microprocessor based systems through 8255. 8237 DMA controller and interfacing with 8086 μp.

Programmable communication interface- Intel 8251 USART. Programmable Interrupt Controller- 8259A.

MODULE V:

Introduction to single chip microcontrollers: Intel MCS-51 family features, 8051/8031 architecture, pin configuration, I/O ports and Memory organization.

Instruction set and basic assembly language programming. Interrupts, Timer/Counter and Serial Communication. MCS-51 applications: Square wave and pulse wave generation, LED, A/D Converter and D/A Converter interfacing to 8051.

Introduction to PIC micro-controller.

TEXT BOOKS:

1. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and application with 8085", 4th Edition, Prentice Hall of India, New Delhi.
2. Ray & Bhurchandi – Advanced Microprocessors & Peripherals, Tata McGraw-Hill
3. Muhammed Ali Mazidi and Janice Gillispie Mazidi – The 8051 Microcontroller and Embedded Systems, Pearson Education Inc.

REFERENCE BOOKS:

1. Barry B. Brey – The Intel Microprocessors, PHI/Pearson Ed. Asia
2. Ajay V Deshmukh – Microcontrollers Theory and Applications, Tata McGraw-Hill
3. Walter A. Tribel – The 8088 and 8086 Microprocessors, Pearson Education
4. Douglas V. Hall – Microprocessors & Interfacing, Tata McGraw-Hill

EI 1309	**VIRTUAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**3**	**0**	**0**	6

Semester- 6

UNIT I : VIRTUAL INSTRUMENTATION

Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

UNIT II : VI PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III : DATA ACQUISITION BASICS

Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT IV : CHASSIS REQUIREMENTS

Common Instrument Interfaces: Current loop, RS 232C/ RS 485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT V :VI TOOL SETS

Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process data base management system, Simulation of systems using VI, Development of Control system, Industrial

Communication, Image acquisition and processing, Motion control.

(for proper understanding & practice in LabVIEW, laboratory class room may be used for teaching where necessary)

Text Books:

1. Gary Johnson, "LabVIEW Graphical Programming", 2nd Edition, McGraw Hill, New York.
2. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall, New Jersey.
3. Jane W. S. Liu, "Real-time Systems", Pearson Education India.
4. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", 2nd Edition, CMP Books.

Reference Books:

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes.
2. Jean J. Labrosse, "MicroC/OS-II. The Real-time Kernal", CMP Books.

Web Resources:

1. www.ni.com
2. www.ltrpub.co

EI- 1314	**MICROPROCESSORS AND MICROCONTROLLERS LAB**	**L**	**T**	**P**	**C**
	Pre-requisite- EI 1308	0	0	2	2

Semester- 6

LIST OF EXPERIMENTS

1. Programs for 8/16 Bit Arithmetic Operations (Using 8085).
2. Programs for Sorting and Searching (Using 8085, 8086).
3. Programs for String Manipulation Operations (Using 8086).
4. Programs for Digital Clock and Stop Watch (Using 8086).
5. Interfacing ADC and DAC.
6. Parallel Communication between Two Microprocessor Kits using Mode 1 and Mode 2 of 8255.
7. Interfacing and Programming 8279, 8259, and 8253.
8. Serial Communication between Two Microprocessor Kits using 8251.
9. Interfacing and Programming of Stepper Motor and DC Motor Speed control.
10. Programming using Arithmetic, Logical and Bit Manipulation Instructions of 8051Microcontroller.
11. Programming and Verifying Timer, Interrupts and UART Operations in 8031 Microcontroller.
12. Communication between 8051 Microcontroller kit and PC.
13. Microcontroller experiments based on VI.

EI 1315	**INSTRUMENTATION LAB**	**L**	**T**	**P**	**C**
	Pre-requisite- EI-1301 & EI-1305	**0**	**0**	**2**	**2**

Semester- 6

LIST OF EXPERIMENTS:

1. Instrumentation amplifier using Op-Amps-gain and CMRR
2. Active notch filter/Narrowband active filter (using Op-Amp)
3. Analog to digital converter circuit, 4. Digital to analog converter circuit
4. Frequency to voltage converter- Voltage to frequency converter
5. Astable and monostable multivibrators using IC 555
6. Voltage regulators: IC 723, 78XX, 79XX family
7. Design of PLL for given lock and capture ranges, frequency multiplication
8. Study of dead weight tester and calibration of pressure gauge
9. Measurements using Photocell/LDR
10. Temperature measurement using RTD

11. Temperature measurement–using thermocouple–using diode
12. Measurement of distance using ultrasonic method
13. Measurement of PH and viscosity
14. Measurement of level- Flow measurement
15. Measurement of Discharge coefficient of orifice plate.
16. Calibration of thermocouple and signal conditioning.
17. Calibration of RTD and signal conditioning of RTD.
18. Study of spectrum with UV-Visible Spectrophotometer and IR Spectrophotometer.
19. Level transmitter.
20. pH meter standardization and measurement of pH values of solutions.

EI 1316	DIGITAL SIGNAL PROCESSING LAB	L	T	P	C
	Pre-requisite- None	0	0	2	2

Semester- 6

List of Experiments:

1. To represent basic signals (unit step, unit impulse, ramp, exponential l, sine and cosine)
2. Response of discrete-time systems for test inputs.
3. a) addition, b) subtraction c) shifting d)multiplication, and e) convolution
4. To develop program for discrete convolution
5. To develop program for discrete correlation
6. To understand stability test
7. To understand sampling theorem
8. To design Analog filters (low-pass, high – pass, band –pass, band -stop)
9. To design digital IIR filters(low-pass, high-pass, band-pass, band-stop)
10. To design FIR filters using windows technique
11. To design a program to compare direct realization values of IIR digital filter
12. To develop a program for computing parallel realization values of IIR digital filter
13. To develop a program for computing cascade realization values of IIR digital filter
14. To develop a program for computing inverse Z-transform of a rational transfer function
15. Design of digital filters-Butterworth and Chebyshev
16. Obtaining DTFT and DFT
17. Assembly-level/High-level language program for the following operations on discrete-time signals
18. Assembly-level/High-level language program for convolution using overlap add/overlap save method
19. Assembly-level/High-level language program for FFT Computation
20. Interfacing of on chip peripherals with a DSP kit
21. FIR filter design using a DSP kit
22. IIR Filter Design using a DSP kit.
23. VHDL Code: Analyzing & Simulation of basic digital circuits: Adder, Flip-flops (2 expts.)
24. Multiplexer, etc.(2 experiments)
25. Simulation of State machine model, Binary to Excess-3 converter
26. Synthesis: using FPGA/CPLD (Example: Xlinix, Altera, etc) (2 Experiments)
27. To study operation of Tuned RF amplifier and plot the frequency response.
28. To find the modulation index of an AM Wave.
29. To find the demodulation of an AM Wave,and also find the modulating frequency.
30. To study the frequency response of the intermediate frequency transforms (IFT).

EI 1401	ADVANCED INSTRUMENTATION	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 7

UNIT I

Introduction, Instrumentation-Functional elements of an instrumentation system-Data acquisition systems-DAS; Sensors & transducers, emerging fields, types of sensors, their parameters.

UNIT II

Microelectronic and micro electro-mechanical systems, Primary sensing principles and measurement variables, Sensor performance characteristics and terminology.

Transducer measurement circuits, Signal conditioning circuits, Sensor data acquirement. Basic principles of the acquirement and transmission of the data; Fibre-optic sensors-types, working, applications.

Bio-medical Instrumentation; Selection of Transducers and Electrodes, Transmission and reception aspects of Bio-Medical signals.

UNIT III

Non Destructive Testing-NDT tools-Ultrasonics-Pulse Echo method of Flaw detection-Eddy-current testing-Signature analysis. Gas Chromatography. Nucleonic sensors & their applications.

UNIT IV

Intelligent Sensor Systems- Intelligent pressure, Flow, Level, Temperature Sensors, Intelligent sensor application in process control, Complex sensors, biometric sensors, Application of intelligent sensor in biomedical engineering;

UNIT V

Future scope of intelligent instruments- Structure, definitions and concepts, Smart sensors, Case study: the "electronic nose", The future of intelligent sensor systems- Multimodal sensors for target recognition, subject tracking, and event understanding.

Real World Interfacing – LCD, ADC, Sensors, Stepper motor, keyboard and DAC, USB interfacing, etc.

TEXT BOOKS:

1. I. R. Sinclair, Sensors and Transducers, John Wiley & Sons.

REFERENCE BOOKS:

1. J. R. Brauer, Magnetic Actuators and Sensors, Wiley-IEEE Press.
2. D. Patranabis, Sensors and Transducers, PHI, New Delhi
3. Barney, G.C., Intelligent instruments, Hemel Hempsteao: Prentice Hall.
4. ALAN S. Morris, Principles of Measurement & Instrumentation. New Delhi, PHI Pvt. Ltd.

EI 1402	**IC & VLSI DESIGN**	**L**	**T**	**P**	**C**
	Pre-requisite- None	**3**	**0**	**0**	**6**

Semester- 7

UNIT I

Introduction IC Technology, IC design flow, MOSFET characteristics, parameters and models. MOSFET as diode, capacitor, switch etc.

UNIT II

Single stage amplifiers - CS, CG, Source follower, Cascode stage, frequency response of circuits. Current Mirror, CMOS Differential pair. Negative feedback, Feedback amplifiers, Op-amp - Two-stage op-amp and frequency compensation.

UNIT III

NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, transfer characteristics, noise margin. Logic Families - NMOS, PMOS, CMOS, Pass transistor, TGL, Domino CMOS and Dynamic CMOS logic. Sequential logic circuits.

UNIT IV Gate realization using CMOS, Introduction to Reconfigurable Hardware – HDL basics. VLSI Design Flow, Different levels of circuit abstraction, Introduction to ASIC and FPGA.

TEXT BOOKS

1. P.E. Allen and D.R.Holberg; CMOS Analog Circuit Design; Oxford University Press, 2004.
2. R.J.Baker, H. W. Li, D. E. Boyce; CMOS Circuit Design, Layout, and Simulation; PHI, 2002.

3. J. M. Rabaey, A. Chandrakasan and B. Nikolic, *Digital Integrated Circuits: A Design Perspective*, Second Edition, Pearson/PH, 2003.

REFERENCE BOOKS

1. J. P. Uyemura, *Introduction to VLSI Circuits and Systems*, Wiley, 2001.
2. W.Wolf, *Modern VLSI Design: Systems-on-Chip Design*, Third Edition, Pearson/PH, 2002.
3. R. L. Geiger, P. E. Allen and N. R. Strader, *VLSI Design Techniques for Analog and Digital Circuits*, McGraw-Hill, 1990.
4. P.R.Gray, P.J.Hurst, S.H.Lewis and R.G.Meye; Analysis and Design of Analog Integrated Circuits, John Wiley & Sons, Fourth Edition, 2003.

EI-1411	INSTRUMENTATION AND AUTOMATION LAB	L	T	P	C
	Pre-requisite- None	0	0	2	2

Semester- 7

LIST OF EXPERIMENTS:

1. Automatic Level Control in a Tank.
2. Automatic Speed Control of DC Motor.
3. Automatic Flow Control in a Process.
4. Automatic Temperature Control in a Process.
5. Smart Traffic light Controller.
6. Robot Arm Control.
7. Design of an Alarm System for Fire Detection.
8. Dynamic simulation for On-Off Temperature Control & Ratio Control
9. Dynamic simulation for Effect of PI Controller on Flow Control Loop & Level Control Loop
10. Dynamic simulation for Split Range Pressure Control & Effect of PI Controller on Pressure Control Loop
11. Dynamic simulation for Direct and Cascade Control & Feedback and Feed forward Control
12. Three Element Boiler Control, Control Valve Characteristics & Inherent Characteristics Co-Efficient of Control Valve
13. Basic Instrumentation Troubleshooting System
14. Simulation of process industries: a) Refinery, b) basic process models, c) Fertilizer, d) Power & utilities

EI 1403	REAL TIME EMBEDDED SYSTEMS	L	T	P	C
	Pre-requisite- None	3	0	0	6

Semester- 8

UNIT I: INTRODUCTION

Definition, embedded system overview, classifications, Design challenges, processor technology, IC technology and Design Technology and trade-offs. Examples of embedded systems. Typical examples of RTS-characteristics features of real-time-structural, functional and performance requirements of reactive real-time system-distinctive features from non-real-time and off-line systems.

UNIT II: SYSTEM DESIGN

Definition, Classification and brief overview of microcontrollers, microprocessors and DSP"s. Embedded Processor architecture definitions. Typical application scenarios of embedded systems. Tools: Simulator, in-circuit debugger, in-circuit emulator, programmers, integrated development environment (IDE), cross compilers. Introduction and Architecture of PAL, PLA, CPLD, FPGA, ASIC, PSOC.

UNIT III: TECHNIQUES FOR EMBEDDED SYSTEMS

State machine and state tables in embedded design, simulation and emulation of embedded systems. High-level language description of S/W for embedded system, Java based embedded system design.

UNIT IV: MODELLING RTS

Event based, Process based and graph based models, petrinet models-representation of time concurrency and distributed in discrete event systems-examples of modelling practical systems. Introduction to RTOS, RTOS Scheduling models, interrupt latency and response time - performance metrics.

UNIT V: CASE STUDIES

Study of embedded system configurations (involving A/D, D/A, memory and I/O) using MC68HC11, MC8051, ADSP2181 and PIC series of micro-controllers. Interfacing keyboard, displays, ADC, DAC, relay, optoisolator, Frequency counter, Stepper motor control.

TEXT BOOKS:

1. Ball. S.R, Embedded microprocessor Systems: Real world Design, Prentice Hall, 1996
2. Herma. K., Real Time Systems: Design for distribution embedded applications, Kluwer Academic 1997.
3. Krishna C.M., Real Time systems , Mc-Graw-Hill Singapore,1998.
4. Rajkamal, *Embedded Systems Architecture Programming and Design*, McGraw Hill, Second Edition.

REFERENCE BOOKS:

1. Levi S. and Agarwala A.K., Real- Time System Design , Mc-Graw-Hill, NewYork,1990.
2. Laplante P.A., Real- Time Systems Design and Analysis , EEE Press, NewYork, 1992
3. Stuart Bennett, Real-time Computer Control , Prentice Hall, London,1998.
4. Gassle J., Art of Programming Embedded systems, Academic Press 1992

ELECTIVES- I

EI 1421 **MEMS AND NANO TECHNOLOGY**

	L	T	P	C
Pre-requisite- None	3	0	0	6

UNIT I : INTRODUCTION

Micro and nano-scale size domains,Scaling of physical laws, MEMS materials and processes; MEMS devices and applications, Nanostructures in semiconductors and metals, Introduction to quantum effects in nanostructures, Nanostructure applications.

UNIT II : FABRICATION TECHNOLOGIES

Semiconductor materials, Photolithography, Doping, thin film growth and deposition; metallisation; wet and dry etching; silicon micromachining; metal MEMS processes; nanofabrication methods – submicron optical lithography; electron beam lithography.

UNIT III : MEMS SENSORS AND ACTUATORS

Mechanics including elasticity, Beam bending theory, membranes/plates, microactuators based on various principles e.g. electrothermal, electrostatic, electromagnetic, piezoelectric and SMA; actuator applications e.g. inkjet, electrical and optical switching, physical sensors e.g. acceleration, strain, flow, chemical sensors.

UNIT IV : MICROFLUIDICS

Scaling laws for microfluidics, transport in micro-channels, microfluidic components e.g. filters, mixers/reactors, valves/controllers, pumps.

UNIT V : GROWN NANOSTRUCTURES

Si nanowires and nanocrystals, carbon nanotubes, nanostructures in III-V materials; metal nanostructures, devices using grown nanostructures.

UNIT VI : NANOELECTRONIC SEMICONDUCTOR DEVICES

The nano-scale MOSFET, Short channel effects in a nano-MOSFET, „scaling" of MOSFETs; scaling of semiconductor memory (FLASH and Random Access memory), bio-sensors.

UNIT VII : QUANTUM DEVICES IN NANOSTRUCTURES

Electron tunnelling; quantum confinement effects; single-electron effects; ballistic transport; optical properties of nanostructures; quantum dots; quantum point contacts; single-electron transistor; single-electron memory and logic.

TEXT BOOKS:

1. Micro Electro Mechanical System Design, James J. Allen - CRC Press.
2. Nanotechnology by Richard Booker, Earl Boysen, Wiley Publishing Inc., 2006.
3. Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens, John Wiley & Sons Publications, 2003.

REFERENCE BOOKS:

1. "MEMS and nanotechnology based sensors and devices for communications medical and Aerospace applications", Jha A. R. - CRC Publications.
2. "MEMS Design and fabrication" Mohamed Gad-El-Hak – CRC Press.
3. "MEMS : A Practical Guide to Design, Analysis and Applications" Jan G Korvink, Oliver Paul – Springer-Verlag.
4. MEMS & MOEMS Technology and Applications- P. Rai Choudhury

EI 1422	PRECISION INSTRUMENTATION	L	T	P	C
	Pre-requisite- None	3	0	0	6

UNIT I

Introduction, Instrument characteristics-accuracy, precision, repeatability, reproducibility, constituent elements in instrumentation; precesion measurements, errors, calibration of instruments.

UNIT II

Standard cell, standard resistors, cylindrical cross capacitors; Transformer double bridge

UNIT III

Ultrasonics-principle-instrumentation; NDT tools, Magnetic particles, dye penetrants, pulse-echo method, signature analysis, US holography.

UNIT IV

Fibre-optic sensors-instrumentation; LASER- introduction, principle, types, sources, instrumentation; sensors for manufacturing-distance sensing

UNIT V

Digital instruments in precision measurements: Digital multimeter, DSO, MDO, Arbitrary function generators, Intelligent instrumentation-definition, basic elements, working-application-case studies;

UNIT VI

Smart sensor-introduction-primary sensors-excitation-amplification-filters-converters-compensation-nonlinearity approximation & regression-noise & interference-response time-cross sensitivity-information coding/processing-data communication-the automation.

Books:

1. D. Patranabis, Sensors and Transducers, PHI, New Delhi
2. Barney, G.C., Intelligent instruments, Hemel Hempsteao: Prentice Hall.
3. ALAN S. Morris, Principles of Measurement s Instrumentation. New Delhi, PHI Pvt. Ltd.

EI 1423 **ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS** **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT I : ARTIFICIAL INTELLIGENCE

AI – Intelligent agents – Perception – Natural language processing – Problem – Solving agents – Searching for solutions – Uniformed search strategies – Informed search strategies

UNIT II : KNOWLEDGE AND REASONING

Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents – Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

UNIT III :UNCERTAIN KNOWLEDGE AND REASONING

Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye‟s rule – Probabilistic reasoning – Making simple decisions

UNIT IV : PLANNING AND LEARNING

Planning – Planning problem – Partial order planning – Planning and acting in non-deterministic domains – Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active

UNIT V : EXPERT SYSTEMS

Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge representation in expert systems – Expert system tools – MYCIN – EMYCIN

TEXT BOOKS

1. Stuart Russel and Peter Norvig, “Artificial Intelligence a Modern Approach”, 2nd Edition, Prentice Hall of India.
2. Donald A.Waterman, “A Guide to Expert Systems”, Pearson Education.

REFERENCE BOOKS:

1. George F. Luger, “Artificial Intelligence – Structures and Strategies for Complex Problem Solving”, 4th Edition, Pearson Education.
2. Elain Rich, Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill.
3. Janakiraman, Sarukesi, K., “Foundations of Artificial Intelligence and Expert Systems”, Macmillan Series in Computer Science.
4. Patterson, W., “Introduction to Artificial Intelligence and Expert Systems”, Prentice Hall of India.

EI 1424 **ROBOTICS AND AUTOMATION** **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT – I INTRODUCTION

Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator-DC motor horse power calculation, magnetostrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors

–ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems – Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT – II : ROBOT CONTROL

Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control-PD gravity control- computed torque control- variable structure control- Impedance control.

UNIT – III :END EFFECTORS

End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation-continuous path motion-interpolated motion-straight line motion.

UNIT – IV: ROBOT MOTION ANALYSIS

Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link

coordinates-Homogeneous transformations and rotations and Robot dynamics .

UNIT – V : ROBOT APPLICATIONS/AUTOMATION

Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

TEXT BOOKS:

1. Mikel P. Grover,et. Al. "Industrial Robots – Technology Programming and Applications", McGraw Hill.
2. Robert J.Schilling, Fundamentals of Robotics-Analysis and Control, PHI. (Unit-II and Unit-III)

REFERENCE:

1. K.S.Fu,R.C.Gonzalez, CSG. Lee, Robotics,control sensing vision and Intelligence, Tata McGraw-Hill.

EI 1425	WIRELESS COMMUNICATION	L T P C
	Pre-requisite- Non	3 0 0 6

UNIT I : INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS

Evolution of mobile radio communications, examples of wireless comm. systems, paging systems, Cordless telephone systems, comparison of various wireless systems.

UNIT II : MODERN WIRELESS COMMUNICATION SYSTEMS

Second generation cellular networks, third generation wireless networks, wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks.

UNIT III : INTRODUCTION TO CELLULAR MOBILE SYSTEMS:

Spectrum Allocation, basic Cellular Systems, performance Criteria, Operation of cellular systems, analog cellular systems, digital Cellular Systems.

UNIT IV : **CELLULAR SYSTEM DESIGN FUNDAMENTALS**

Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity

UNIT V : MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION

Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

UNIT VI : **WIRELESS NETWORKING**

Difference between wireless and fixed telephone networks, development of wireless networks, fixed network transmission hierarchy, traffic routing in wireless networks, wireless data services, common channel signaling, ISDN (Integrated Services digital Networks), advanced intelligent networks.

UNIT VII : INTELLIGENT CELL CONCEPT AND APPLICATION

Intelligent cell concept, applications of intelligent micro-cell Systems, in-Building Communication, CDMA cellular Radio Networks.

TEXT BOOKS:

1. Wireless Communications: Theodore S. Rappaport; Pearsons.
2. Mobile Cellular Telecommunication: W.C.Y.Lee; McGraw Hill.

REFERENCE BOOK:

1. Mobile Communications: Jochen Schiller; Pearson.

EI 1426	OPERATING SYSTEM S	L T P C
	Pre-requisite- None	3 0 0 6

UNIT I: COMPUTER SYSTEM AND OPERATING SYSTEM OVERVIEW

Overview of computer operating systems operating systems functions protection and security distributed systems special purpose systems operating systems structures and systems calls operating systems generation

UNIT II : **PROCESS MANAGEMENT**

Process concepts threads, scheduling-criteria algorithms, their evaluation, Thread scheduling, case studies UNIX, Linux, Windows

UNIT III: CONCURRENCY

Process synchronization, the critical- section problem, Peterson‟s

Solution, synchronization Hardware, semaphores, classic problems of synchronization, monitors, Synchronization examples, atomic transactions. Case studies UNIX, Linux, Windows

UNIT IV: MEMORY MANAGEMENT AND PRINCIPLES OF DEADLOCK

Swapping, contiguous memory allocation, paging, structure of the page table , segmentation, virtual memory, demand paging, page-Replacement, algorithms, case studies UNIX, Linux, Windows

System model and deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock, I/O systems, Hardware, application interface, kernel I/O subsystem, Transforming I/O requests Hardware operation, STREAMS, performance.

UNIT V: FILE SYSTEM INTERFACE AND FILE SYSTEM IMPLEMENTATION

The concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.

File system structure, file system implementation, directory implementation, directory implementation, allocation methods, free-space management, efficiency and performance, case studies. UNIX, Linux, Windows

UNIT VI: MASS-STORAGE STRUCTURE

Overview of Mass-storage structure, Disk structure, disk attachment disk scheduling, swap-space management, RAID structure, stable-storage implementation, Tertiary storage structure.

UNIT VII: PROTECTION AND SECURITY

Protection, Goals of Protection, Principles of Protection, Domain of protection Access Matrix, Implementation of Access Matrix, Access control, Revocation of Access Rights, Capability- Based systems, Language – Based Protection, The Security problem, program threats, system and network threats cryptography as a security tool, user authentication, implementing security defenses, firewalling to protect systems and networks, computer – security classifications, case studies UNIX, Linux, Windows.

TEXT BOOKS :

1. Abraham Silberchatz, Peter B. Galvin Operating System Concepts-, Greg Gagne 7th Edition,John Wiley.
2. D. M.Dhamdhere , Operating systems- A Concept based Approach, 2nd Edition, TMH

REFERENCES :

1. Stallings, „Operating Systems‟ – Internal and Design Principles, Fifth Edition–2005, Pearson education/PHI
2. Crowley, Operating System A Design Approach, TMH.
3. Andrew S Tanenbaum, Modern Operating Systems, 2nd edition Pearson/PHI.

ELECTIVE-II

EI 1431 **INTELLIGENT AND KNOWLEDGE BASED SYSTEMS** **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT I

Introduction-intelligent & knowledge based systems.

UNIT II

Problem solving: state space representation, problem reduction, constraint satisfication networks. Heuristics. Knowledge Representation Predicate calculus, resolution-refutation, Prolog.

UNIT III

Rule based systems: forward and backward chaining. Handling of uncertainty: probabilistic techniques, fuzzy logic. Reasoning with incomplete information: non-monotonic reasoning.

UNIT IV

Elements of temporal logic. Diagnostic reasoning. Structured Knowledge Representation Schemes: Semantic networks, Frames, Inheritance and default reasoning.

UNIT V

Expert Systems: Architecture of the expert systems. Expert system shells. Knowledge acquisition. Consistency of the knowledge base. Case studies. Distributed AI and agent based systems.

Reference books:

1. Fuzzy Sets and Fuzzy Logic, G. J. Klir PHI.
2. Fuzzy Set theory and its Application, H. J. Zimmerman Kluwer Academic Publisher.

EI 1432 **RENEWABLE ENERGY SOURCES AND MANAGEMENT** **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT I: SOLAR ENERGY

Principles and scope, solar radiation, Energy collection and devices.Principle of Wind Energy Conversion.Tidal and geothermal Energy.

UNIT II : BIO-ENERGY

Biomass and its uses, Classification of biomass, Biomass as a source of energy, Characteristics of biomass, Biomass conversion processes, Buiqueting of biomass, Gasification and combustion of biomass, Gasifiers.

UNIT III : BIOMETHANATION

Basics of anaerobic processes, advantages, Biogas as a rural energy source, Environmental significance, Biogas production mechanism, Biogas plant and its components, Types of biogas plants, Design and construction features

UNIT IV : HYDEL ENERGY

Types of Hydro Power Plants, Hydro Power Estimates â€ " Hydrological analysis, Flow & power duration curves, Effect of storage, load analysis &Pondage requirement, estimates of Primary and Secondary Power, Hydraulic Turbines : Types of turbines, their parts and working, Governing and controls of turbines

UNIT V : GENERAL ENERGY PROBLEM

Energy use patterns and scope for conservation,Energy audit: Energy monitoring, Energy accounting and analysis, Energy Audit, Energy Accounting & Analysis, Heating, Ventilation & Air Conditioning audit, Building system energy audit.

UNIT VI : ENERGY MANAGEMENT, ENERGY MANAGEMENT INFORMATION SYSTEM.

Electrical Energy Conservation in building, heating and lighting. domestic gadgets, Energy efficient motors, Tariffs and power factor improvement in power system, Load curve analysis and load management.

UNIT VII : ENERGY AUDIT, ENERGY ACCOUNTING & ANALYSIS

Thermodynamics of Energy Conservation. Basic principle. Irreversibility and second law efficiency analysis of systems. Primary energy sources, optimum use of prime-movers, energy efficient housekeeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Thermal energy audit in heating, ventilation and air conditioning. Maintenance and Energy audit â€ " friction, lubrication and tribo-logical innovations. Predictive and preventive maintenance.

Books:

1. Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M.
2. Energy management by Paula Callaghan

EI 1433 **PC BASED INSTRUMENTATION SYSTEM** S **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT I

Introduction, Necessity and functions of computers. Level of automation and economy of computer control. Centralized computer control Vs distributed computer control.

UNIT II

Computer architecture, Micro and mini-computer, functional models of I.O. system ,interfacing, Sampling

UNIT III

Multiplexing; A/D and D/A converters, interfacing with different types of transducers - Analog / Digital, Electrical and non electrical selection of sensors; Micro computer interfacing standard buses Serial buses; Serial data communication protocols.

UNIT IV

Study of automatic process control, Fundamental of automatic process control, building block of automatic system, direct and distributed digital control system. Programmable controllers.

UNIT V

Personal computer in real life environment, Introduction, personal computer: system and facility, PC bus and signals, interrupts, interfacing PC with outer world, PC in RTE, Real time application of IBM PC PC based distributed control system

UNIT VI

Programming and application, Modeling and simulation for plant automation, PLC Architecture and programming of PLC, industrial

control application: cement plant, thermal power plant , water treatment plant, steel plant,

Text Books :

1. Computer based industrial control: Krishan Kant, PHI.
2. PC-based Instrumentation: Concepts And Practice (Paperback), N. Mathivanan, PHI

EI 1434 **HIGHER POWER SEMICONDUCTOR DEVICES** **L T P C**

Pre-requisite- Non **3 0 0 6**

UNIT I: BASICS ABOUT POWER SEMICONDUCTOR DEVICES

Key devices concepts and electrical characteristics, challenges in SMART Power Integration, Basic semiconductor structures of major and their comparison based on carrier concentration profiles.

UNIT II: BASIC UNDERSTANDING OF POWER SEMICONDUCTOR DEVICES PHYSICS

Semiconductor material and conductivity, PN- Structure, crystal structure, Fermi level, intrinsic and extrinsic semi-conductor , carrier concentration , Hall effect generation, junction breakdown, tunneling current small signal ac analysis, SCR, blocking capability

UNIT III: FAST SWITCHING POWER DIODE (FRED DIODE)

Reverse blocking capability, build up and remove Electron- Hole-Plasma during turn-on and turn-off intervals, dynamic performance of FRED diode, Limits of FRED-Diode and development trend

UNIT IV: UNIPOLAR DEVICE CONCEPT (POWER MOSFET)

Basics of MOS- Controlled device, power MOSFET cell structure, static and switching behavior, device parasites and impact on dynamic performance, super junction device, characteristics and difference to conventional technologies, new development in low voltage power MOSFET and challenges in application, device limits, avalanche behavior and future design criteria, driving and protection

UNIT V: UNIPOLAR DEVICE CONCEPT BASED ON SiC MATERIAL

SiC schottky diode and electrical performance, Device limits and benefit in application, SiC- JEFT and electrical behavior, future development trends, ultra fast switching challenges in Power Converter Systems

UNIT VI: MOS- CONTROLLED BIPOLAR MODEL DEVICE(IGBT)

Basics of carrier modulated devices, static and dynamic performance (electron-hole –plasma modulation), overload characteristics, short circuit capability and destruction modes, avalanche characteristics, di/dt, dv/dt limits and physical effect, driving and protection circuit for low and high power devices, impact of fast switching to circuit and device parasites, thermal management and loss calculation

Text books:

1. M.H Rashid, Power Electronics, 2nd Edition, Prentice-Hall International Inc.

References:

1. C.W. Lander, Power Electronics, 2nd edition, McGraw- Hill.
2. J. Kassakian, M. Schlecht, G. Verghese, Principles Of Power Electronics, Addison –Wesley Pub.

EI 1435	BIOMEDICAL INSTRUMENTATION	L T P C
	Pre-requisite- Non	3 0 0 6

UNIT I : INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

Electro physiology: Review of physiology and anatomy, resting potential, action potential, Nerst equation, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems, Safety consideration in the use of electrical systems for in-vivo measurements.

UNIT II :BIOELECTRIC POTENTIAL AND CARDIOVASCULAR MEASUREMENTS

EMG - Evoked potential response, EEG. ECG phonocardiography, vector cardiograph, impedance cardiology, cardiac arrhythmia‟s, pace makers, defibrillators. Blood pressure measurements – manual / automatic systems, invasive and non invasive types, Sphygmomanometer, Blood flow measurements using ultrasonic and electromagnetic flowmeters, plethysmography.

UNIT III : RESPIRATOR AND PULMONARY MEASUREMENTS AND REHABILITATION

Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotheraphy, diathermy, nerve stimulator, artificial kidney machine.

UNIT IV : PATIENT MONITORING SYSTEMS

Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.

UNIT V : RECENT TRENDS

Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy, PET SCAN.

TEXT BOOK:

1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, Prentice Hall, New Delhi.
2. R. S. Kandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

1. Nandini K.Jog, "Electronics in Medicine and Biomedical Instrumentation",4th Edition ,PHI.
2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company, New York.
3. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York.

EI 1436	**INTELLIGENT INSTRUMENTATION**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT I-INTRODUCTION:

Intelligence, features characterizing intelligence, intelligent instrumentation system; features of intelligent instrumentation; components of intelligent instrumentation system. Block diagram of an intelligent instrumentation system.

UNIT II-SIGNAL PROCESSING, MANIPULATION AND TRANSMISSION

Signal amplification & attenuation (OP-AMP based); Instrumentation Amplifier (circuit diagram, high CMRR& other features); Signal Linearization (different types such as Diode resistor combination, OP-AMP based, etc.(; Bias Removal, Signal filtering (outputs from ideal filters, outputs form constant-k filters, matching of filter sections, active analog filters);OP-AMP based Voltage-to-current converter, Current-to-voltage conversions, Signal integration, Voltage follower (pre amplifier); voltage comparator, Phase –Locked loop, Signal addition, Signal multiplication, Signal Transmission (Signal amplification, Shielding , Current loop transmission, Voltage-to-frequency conversion, Fiber optic transmission).

UNIT III-SMART SENSORS

Primary sensors; Excitation; Compensation (Nonlinearity: look up table method, polygon interpolation, polynomial interpolation, cubic spline interpolation, Approximation & regression: Noise & interference; Response time: Drift; Cross-sensitivity); information coding/Processing; Data Communication; Standards for smart sensor interface

UNIT IV-INTERFACING INSTRUMENTS & COMPUTERS

Address decoding; Data transfer control; A/D converter; D/A converter; Sample & hold circuit; others interface considerations.

UNIT V-RECENT TRENDS IN SENSOR TECHNOLOGIES

Introduction; Film sensors (Thick film sensors, this film sensor) Semiconductor IC Technology- Standard methods; Micro electro- mechanical systems (Micro-machining, some application examples); Nono-Sensors.

TEXT BOOK

1. Barney, G.C., Intelligent instruments, Hemel Hempsteao: Prentice Hall.
2. ALAN S. Morris, Principles of Measurement s Instrumentation. New Delhi, PHI Pvt. Ltd.

REFERENCE BOOK:

1. D.Patranabis, Sensors s Transducers, New Delhi, PHI.
2. Roman Kuc, Introduction to Digital Signal Processing, New York: McGraw-Hill Pub. Co.

EI 1437 **LOGIC AND DISTRIBUTED CONTROL SYSTEMS** **L T P C**

Pre-requisite- None **3 0 0 6**

Unit I

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. Digital controller modes: Error, proportional, derivative and composite controller modes.

Unit II

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.

Unit III

PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions.

Unit IV

Interface and backplane bus standards for instrumentation systems. Field bus: Introduction,

concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.

Unit V

Distributed control systems (DCS): Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS.

TEXT BOOKS

1. John. W. Webb Ronald A Reis , Programmable Logic Controllers - Principles and Applications, Third edition, Prentice Hall Inc., New Jersey, 1995.
2. Lukcas M.P Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

REFERENCES

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, NewYork, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, Fourth edition, PHI

ELECTIVES – III

EI 1441 **MECHATRONICS** **L T P C**

Pre-requisite- Non **3 0 0 6**

UNIT I: INTRODUCTION

Mechatronics – Definition and key issues – Evolution – Elements – Mechatronics approach to modern engineering design.

UNIT II : SENSORS AND TRANSDUCERS

Types – Displacement – Position – Proximity and velocity sensors – Signal processing – Data display.

UNIT III: ACTUATION SYSTEMS

Mechanical types – Applications – Electrical types – Applications – Pneumatic and hydraulic systems – Applications – Selection of actuators

UNIT IV: CONTROL SYSTEMS

Types of controllers – Programmable logic controllers – Applications – Ladder diagrams –Microprocessor applications in mechatronics – Programming interfacing – Computer applications.

UNIT V: RECENT ADVANCES

Manufacturing mechatronics – Automobile mechatronics – Automobile mechatronics – Medical mechatronics – Office automation – Case studies

TEXT BOOKS

1. Bulton, N., "Mechatronics Electronic Control system for Mechanical and Electrical Engineering", Longman.
2. Dradly, D.A., Dawson, D, Burd, N.C. and Loader A.J., "Mechatronics: Electronics in Products and Processes", Chapman and Hall.

REFERENCES

1. HMT, "Mechatronics", Tata McGraw-Hill.
2. Galip Ulsoy A. and Devires W.R., "Microcomputer Applications in Manufacturing", John wiley.
3. James Harter, "Electromechanics: Principles, Concepts and Devices", Prentice Hall.

EI 1442	DIGITAL IMAGE PROCESSING	L	T	P	C
	Pre-requisite- Non	3	0	0	6

UNIT I : DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS

Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

UNIT II : IMAGE ENHANCEMENT TECHNIQUES

Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering.

UNIT III : IMAGE RESTORATION

Model of Image Degradation/restoration process – Noise models – Inverse filtering -Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition.

UNIT IV : IMAGE COMPRESSION

Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM, Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG,Basics of Vector quantization.

UNIT V : IMAGE SEGMENTATION AND REPRESENTATION

Edge detection – Thresholding - Region Based segmentation – Boundary representation: chair codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture

TEXT BOOKS:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing - Pearson Education.

REFERENCES:

1. William K Pratt, Digital Image Processing John Willey.
2. Image Processing Analysis and Machine Vision – MillmanSonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy
3. A.K. Jain, PHI, New Delhi -Fundamentals of Digital Image Processing
4. ChandaDuttaMagundar – Digital Image Processing and Applications, Prentice Hall of India.

EI 1443 **INDUSTRIAL COMMUNICATION** **L T P C**

Pre-requisite- Non **3 0 0 6**

Unit I

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Unit II

Interface: Introduction, Principles of interface, serial interface and its standards. Parallel interfaces and buses. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

Unit III

Fieldbus: Use of fieldbuses in industrial plants, functions, international standards, performance, use of Ethernet networks, fieldbus advantages and disadvantages. Fieldbus design, installation, economics and documentation.

Unit IV

Instrumentation network design and upgrade: Instrumentation design goals, cost optimal and accurate sensor networks. Global system architectures, advantages and limitations of open networks, HART network and Foundation fieldbus network.

Unit V

PROFIBUS-PA: Basics, architecture, model, network design and system configuration. Designing PROFIBUS-PA and Foundation Fieldbus segments: general considerations, network design.

TEXT BOOK

1. Noltingk B.E., "*Instrumentation Reference Book*", 2nd Edition, Butterworth Heinemann, 1995.
2. B.G. Liptak, Process software and digital networks, 3rd Edition, CRC

EI 1444 **AUTOMOTIVE INSTRUMENTATION AND CONTROL** **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT I

Sensor for Fuel Level in Tank, Engine Cooling,Water Temperature Sensors Design, Engine Oil Pressure

UNIT II

Sensor Design, Speed Sensor, Vehicle Speed Sensor Design, Air Pressure Sensors, Engine Oil Temperature Sensor, Odometer and Taximeter Design .

UNIT III

Brake Actuation Warning System. Traficators, Flash System, Oil Pressure Warning System, Engine Overheat Warning System, Air Pressure Warning System, Speed Warning System. Door Lock Indicators, Gear Neutral Indicator, Horn Design, Permanent Magnet Horn, Air Horn, Music Horns.

UNIT IV

Basic driveline equations, Modeling of neutral gear, State-space formulation, Driveline speed control, Driveline control for gear shifting.

UNIT V

Vehicle modeling, wheel model, tyre characteristics, complete vehicle model, validation of the model, velocity estimation.

UNIT VI

Vehicle control system, Antilock Braking Systems (ABS), control cycles of ABS, road model, PID driver model, hybrid driver model, model of human information acquisition, complete driver model.

Text Books:

1. U.Kiencke, and L. Nielson, "Automotive Control Systems", Springer Verlag Berlin,
2.

Reference Books:

1. T.Kailath, "Linear Systems", Prentice Hall Inc., New Jersy

2. J.M.Maciejowski, "Multivariable Feedback Design", Addison Wesley, Singapore 3. J.L.Meriam and L.G.Kraige, "Engineering Mechanics, Dynamics", John Wiley and sons, 5th Edition, New York

EI 1445	WAVE BASED INSTRUMENTATION	L T P C
	Pre-requisite- None	3 0 0 6

UNIT - I :BASIC INTERNET CONCEPTS

History of Internet – RFCs, FYIs and STDs – Security – Protocols – Internet addressing – DNS and directory services. Applications of Internet in the field of Internet and Control – Distributed Measurements.

UNIT -II :INTERNET APPLICATION

Electronics Mail, Newsgroups, UUCP, FTP, Telnet, Finger . Data Acquisition using internet – online monitoring and control.

UNIT –III : WORLD WIDE WEB

Overview – Hypertext Mark-up language – Uniform resources locators – HTTP protocol – Common gateway interface – Multipurpose internet mail extensions – Web browsers such as Netscape, Internet Explorer.

UNIT – IV :JAVA PROGRAMMING LANGUAGE

History – Language features – Classes, object and methods – Sub classing dynamic binding – Packages – Exceptions – Multithreading – JVM and security – Over view of class library: I/O, AWT and NET – JDBC, Object serialisation – remote method invocation – Java script – Java vs C++.

UNIT – V : MISCELLANEOUS TOPICS

Intranets – Internet commerce – Internet and VRML – Active X. Case study : Internet based measurement, Telemonitoring and Tele control in Biomedical , instrumentation Applications.

TEXT BOOKS

1. April Marine, Susan Kirkpatrick, Vivian Neou and Carol Ward, „Internet: Getting started", PTR Prentice Hall,
2. Ed Krol, „The whole Internet: User"s guide and catalogue", O"Reilly & Associates Inc..
3. William E. Weinman, „The CGT book", New Riders.

EI 1446	OPTIMIZATION TECHNIQUES	L T P C
	Pre-requisite- None	3 0 0 6

UNIT I : INTRODUCTION:

Statement of Optimization problem, classification.

Classical optimization techniques:

Single variable Optimization, Multivariable optimization (with no constraints, equality constraint & inequality constraints).

UNIT II :LINEAR PROGRAMMING

Standard form of linear programming problem, definition and theorem, Solution of a system of Linear simultaneous equation, Simplex methods, simplex algorithm, Two phases of simplex method Duality in linear programming, sensitivity analysis, transportation problem.

UNIT III : NON LINEAR PROGRAMMING

One dimensional minimization: Unimodal function, elimination methods, Fibonacci method, Golden section method, quadratic interpolation method. **Unconstrained Optimization** : Direct search method – Hooke &

Jeeves pattern search method. Descent method – Fletcher-Reeves method. **Constrained Optimization:** Direct method

– Cutting plane method, Indirect method – Penalty function method both interior and exterior method.

UNIT IV: INTEGER PROGRAMMING

Integer linear programming-graphical representation, cutting plane method. Nonlinear programming-Integer polynomial programming.

UNIT V:NON TRADITIONAL OPTIMIZATION ALGORITHM

Genetic Algorithm – Working principle, Difference and similarities between GAs and traditional methods, GAs for constrained optimization.

Reference Books:

1. Optimization Theory and Application, Rao, S.S. New Age
2. Optimization for Engineering Design, Deb, Kalyanmoy, PHI
3. Introduction to Optimum design Arora, Jasbir, S. McGraw Hill
4. Foundations of Optimization, Beighfler, C.S. PHI
5. Optimization methods in Operation Mital, K. V. New Age
6. Research and System Analysis Operation Research Phillip & Ravindran John Wiley & Sons

EI 1447

INDUSTRIAL MANAGEMENT **L T P C**

Pre-requisite- None **3 0 0 6**

Unit-I

Introduction : Concept, Development, application and scope of Industrial Management.

Productivity : Definition, measurement, productivity index, types of production system, Industrial Ownership.

Unit-II

Management Function : Principles of Management- Management Tools – time and motion study, work simplification- process charts and flow diagrams, Production Planning, Specification of Production requirements.

Unit-III

Inventory control : Inventory, cost, Deterministic models, Introduction to supply chain management.

Unit-IV

Quality control : Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM.

Unit-V

Environmental Issues : Environmental Pollution – various management techniques to control Environmental pollution – Various control acts for Air, Water, Solid waste and Noise pollution.

Books:

1. S.N.Chari, Production and operations management.
2. Basu & Majmundar, Industrial Management, Birla Pub., Newdelhi.
3. N.D.Vohra,Quantitative techniques in management,Tata Mcgraw Hill.
4. Riggs, Production systems analysis and control.
5. Basu, Sahoo & Dutta,Works organization and management.
6. Timothy J. Ross, Fuzzy logic with Engineering applications, Mcgraw Hill.

Reference Books

1. Khanna O.P, Industrial Engineering
2. T.R. Banga, Industrial Engineering and Management
3. Sharma B.R, Environmental and Pollution Awareness.

ELECTIVE-IV

EI 1451	COMPUTER NETWORKS	L T P C
	Pre-requisite- Non	3 0 0 6

UNIT I :DATA COMMUNICATIONS

Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems – RS232 Interfacing sequences.

UNIT II :DATA LINK LAYER

Error – detection and correction – Parity – LRC – CRC – Hamming code – low Control and Error control - stop and wait – go back-N ARQ – selective repeat ARQ- sliding window – HDLC. - LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET – Bridges.

UNIT III :NETWORK LAYER

Internetworks – Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing – Routers.

UNIT IV :TRANSPORT LAYER

Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram

Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services.

UNIT V :APPLICATION LAYER

Domain Name Space (DNS) – SMTP – FTP – HTTP - WWW – Security – Cryptography.

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw- Hill, 2004.
2. Andrew S. Tanenbaum, “Computer Networks”, PHI, Fourth Edition, 2003.

REFERENCES:

1. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Pearson Education, 2003.
2. Larry L.Peterson and Peter S. Davie, “Computer Networks”, Harcourt Asia Pvt. Ltd., Second Edition.

EI 1452	BIOMEDICAL SIGNAL PROCESSING	L T P C
	Pre-requisite- None	3 0 0 6

UNIT I

Discrete and continuous Random variables, Probability distribution and density functions. Gaussian and Rayleigh density functions, Correlation between random variables.

UNIT II

Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems.

UNIT III

Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Hoffman coding, vector quantisation, DCT and the K L transform.

UNIT IV

Cardiological Signal Processing: Pre-processing. QRS Detection Methods. Rhythm analysis. Arrhythmia detection Algorithms. Automated ECG Analysis. ECG Pattern Recognition. Heart rate variability analysis.

UNIT V

Adaptive Noise Canceling: Principles of Adaptive Noise Canceling. Adaptive Noise Canceling with the LMS adaptation Algorithm. Noise Canceling Method to Enhance ECG Monitoring. Fetal ECG Monitoring.

UNIT VI

Signal Averaging, polishing mean and trend removal, Prony‟s method. Linear prediction. Yule walker equations.

UNIT VII

Neurological Signal Processing: Modeling of EEG Signals. Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive(A.R.) modeling of seizure EEG. Sleep Stage analysis. Inverse Filtering. Least squares and polynomial modeling.

UNIT VIII

Original Prony‟s Method, Prony‟s Method based on the Least Squares Estimate, Analysis of Evoked Potentials and PCG.Case study: Brain computer interfacing, data acquision, preprocessing, feature extraction, Application of BCI.

TEXT BOOKS:

1. Rangaraj M. Rangayyan " Biomedical Signal Analysis". IEEE Press, 2001.
2. D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill.
3. Biomedical Digital Signal Processing, Willis J.Tompkins, PHI,

REFERENCE BOOKS:

1. Weitkunat R, Digital Bio signal Processing, Elsevier.
2. Akay M , Biomedical Signal Processing, Academic: Press.
3. Cohen.A, Biomedical Signal Processing -Vol. I Time & Frequency Analysis, CRC Press.

EI 1453 **POWER PLANT INSTRUMENTATION** **L T P C**

Pre-requisite- Non **3 0 0 6**

UNIT I: INTRODUCTION

Piping and instrumentation diagram of a thermal power plant, basic process on a boiler, Fuel measurement-review of pressure and temperature measurement steam and water flow measurement – instrument applications in power stations: review of indicating and recording instrument applications in power stations: review of indicating and recording instruments, water level gauge for boiler drums, closed circuit television instrument, gas analysis meters, smoke instruments, dust monitor-measurement of impurities in feed water and steam generator coolant controls and instruments-instrument maintenance aspects.

UNIT 2: BOILER CONTROL-I

Boiler control objectives-combustion of fuels (gaseous, liquid and solid), excess air, combustion chemistry and products of combustion, requirement for excess combustion, air-circulation of efficiency of boiler: input/output method-stream temperature control systems super heaters and de-super heaters.

UNIT 3: BOILER CONTROL-II

Feed water supply and boiler water circulation system-drum level control systems-boiler draft systems-measurement and control of furnace draft-measurement and control of combustion-draft and air flow control related functions.

UNIT 4:FLUE GAS ANALYSIS TRIMMING OF COMBUSTION CONTROL SYSTEMS

Combustion control for liquid and gaseous fuel boilers coal or solid fuel strokes-combustion control for stoker-fired boilers- pulverised coal-fired boilers. Turbine monitoring and control: speed, vibration, shell temperature monitoring.

UNIT 5: NUCLEAR POWER PLANT INSTRUMENTATION

Piping and instrumentation diagram of different types of nuclear power plants-radiation detection instruments-process sensors for nuclear power plants-spectrum analyzers-nuclear reactor control
systems and allied instrumentation.

TEXT BOOKS:

1. B.G.Liptak, Instrumentation in process industries, Vol. I and II, Chilton books co, 1973.
2. Sam G. Dukelow. The control of boilers, Instrument Society of America press.

REFERENCE BOOKS:

1. A.Sherryet. Al. (Editors), Modern power station practice, Vol.6 (Instrumentation controls and testing), Pergamon Press, 1971.

EI 1454	MOBILE COMMUNICATIONS	L T P C
	Pre-requisite- None	3 0 0 6

UNIT I

Introduction To Cellular Mobile Systems: Basic cellular mobile systems, performance criteria, operation of cellular systems, Planning a cellular system, analog and digital cellular systems.

Elements of cellular Radio system design: Concept of frequency reuse of channels, co-channel interference reduction factor, hand-off mechanism, cell splitting, consideration of the components of the cellular systems.

Co-channel interference Reduction: Co-channel interference, Exploring co-channel interference area in a system, Real time measurement at mobile radio transceivers, Power control, designing a system to serve a predefined area that experiences co-channel interference, near-end-far-end interference, effect of near-end mobile units, cross-talk a unique characteristic of voice channels, interference between system

UNIT II

Frequency Management And Channel Assignment : Frequency management, Frequency spectrum utilization, Set-up channels, Definition of channel assignment, fixed channel assignment, non-fixed channel assignment algorithms, Perception of call blocking from subscribers.

Hand-offs and Dropped calls:Initiation of hand off, delaying an hand off, forced hand off, queuing of hand off, power difference hand off. Mobile Assisted hand off (MAHO) and soft hand off. Cell site hand off only, intersystem hand off. Introduction to dropped call rate.

UNIT III

Introduction To Digital Systems: ARQ techniques, Digital speech, Digital mobile telephony, Practical multiple access schemes. Digital Cellular System : Global system for Mobile (GSM), North American TDMA, CDMA, Miscellaneous such as PDC, CT-2, DECT, CDPD, PCN and PCS.

UNIT IV

Intellient Cell Concept And Applications: Intelligent cell concept, applications of intelligent micro cell systems, in-building communication, CDMA cellular radio network

Intelligent Network For Wireless Communications : Advanced intelligent network (AIN), SS7 Network and ISDN for AIN, AIN for mobile communications, An intelligent system-Future Public Land Mobile Telecommunication System (FPLMTS),wireless information superhighway.

Text Books:

1. William C.Y.Lee, Mobile Cellular Telecommunications.
2. Analog and Digital Systems, McGraw-Hill Electronic Engineering Series.

Reference Books:

1. William C.Y.Lee, Mobile communication Engineering, McGraw Hill.
2. Mike Gallagher, Randy Snyder, Mobile Telecoms Networking with IS-41, McGraw Hill.

EI 1455	NON LINEAR CONTROLS	L T P C
	Pre-requisite- Non	3 0 0 6

UNIT I : LINEAR VERSUS NONLINEAR SYSTEMS

Nonlinear phenomena, multiple equilibria, limit cycles, complex dynamics, manifolds as state space, linearization, methods for nonlinear systems, some classical examples.

UNIT II : PLANAR DYNAMICAL SYSTEMS

Phase plane techniques, limit cycles, Poincar_e-Bendixson theorem, multiple equilibria, index theory, bifurcations(fold, pitch, fork, Hopf, saddle connection)

UNIT III : MATHEMATICAL PRELIMINARIES

Ordinary di_erential equations, control systems, solutions of initial value problems, existence and uniqueness of solutions, continuous dependence on initial conditions and parameters, differential equations with discontinuities, introduction to differential topology.

UNIT IV :LYAPUNOV STABILITY

Definitions of (in)stability, basic (in)stability theorems, converse Lyapunov theorems, LaSalle Invariance Principle, exponential stability theorems, linear systems, feedback stabilization

UNIT V : FEEDBACK LINEARIZATION

SISO systems, input-output linearization, full state linearization, zero dynamics, applications to inversion, tracking and stabilization, MIMO systems, linearization by state feedback, full state linearization, dynamic extension, sliding mode, robust linearization.

UNIT VI : INPUT-OUTPUT STABILITY

Definitions of input-output stability, small gain theorems, passivity, passivity theorems, describing functions, harmonic balance, connections with state space stability.

UNIT VII : GEOMETRIC NONLINEAR CONTROL

Basics of differential geometry, tangent spaces, distributions and co-distributions, Frobenius theorem, controllability concepts, drift less control systems, Chow's theorem, observability concepts, local decompositions, controlled invariant distributions and disturbance decoupling.

TEXT BOOKS:

1. H. K. Khalil, “Nonlinear Systems”, Prentice Hall, Englewood Cli_s, NJ, third edition.
2. S. S. Sastry. Nonlinear Systems: Analysis, Stability and Control. Interdisciplinary Applied Mathematics. Springer Verlag, New York.

REFERENCES:

1. H. Nijmeijer and A. J. van der Schaft, “Nonlinear Dynamical Control Systems”, Springer Verlag, NewYork.
2. A. Isidori. Nonlinear Control Systems. Springer Verlag, New York.
3. E. D. Sontag. Mathematical Control Theory: Deterministic Finite Dimensional Systems, volume 6 of TAM.SpringerVerlag, New York.

EI 1456	**INFORMATION SECURITIES**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT I INTRODUCTION

History, Definition, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT II SECURITY INVESTIGATION

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues

UNIT III SECURITY ANALYSIS

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk

UNIT IV LOGICAL DESIGN

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models,

VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT V PHYSICAL DESIGN

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical, Security, Security and Personnel.

TEXT BOOKS

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi.

REFERENCES

1. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC Press LLC
2. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw-Hill.
3. Matt Bishop, " Computer Security Art and Science", Pearson/PHI.

EI 1457 **VLSI SYSTEMS & APPLICAIONS** **L T P C**

Pre-requisite- None **3 0 0 6**

UNIT I

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies Logic Families - NMOS, PMOS, CMOS, Pass transistor, TGL, Domino CMOS and Dynamic CMOS logics, stick diagram and Device layout, Design rules,

UNIT II

NMOS - PMOS - CMOS devices characteristics - linear, saturation regions,NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, transfer characteristics, noise margin

UNIT III

Gate realization using CMOS-Introduction to Reconfigurable Hardware – HDL basics. VLSI Design Flow, Different levels of circuit abstraction, ASIC and FPGAs, CAD tools. Application Specific Integrated Circuits-Introduction – Types of ASIC – Design Flow of VLSI – Types of Simulation – Programmable ASIC , Floor planning – Placement – Partitioning – Routing of ICs.

UNIT IV

HDL basics - HDL levels of abstraction - Abstraction and timing - The HDL design flow - HDL design entities - Concurrent signal assignments - Signal assignments with delays.

Component declarations - Component instantiation, - Configuration specifications, Objects in HDL - Constants, variables and signals - types - Scalar types - Arrays – Records - Custom types and subtypes

Concurrent statements - Sequential statements - Conditional & selective signal assignments - The generate statement - Signal and variable assignments - For loops while, do-while loops, CASE statements, Functions

UNIT V

HDL synthesis - Modeling hardware in Verilog - Verilog models for multiplexers, Encoders, Decoders, Parity Generators – combinational circuit implementation - compilation and simulation of Verilog code, modeling a sequential machine, Test bench development.

TEXT BOOKS:

1. Introduction to VLSI Design: Fabricius
2. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997
3. Neil Weste & Kamran Eshrangian, Principles of CMOS VLSI Design, Addison Wesley, 2nd edition 1998.

REFERENCES:

1. Douglas Pucknell, Basic VLSI Design Systems and Circuits, Prentice Hall PTR 2000.
2. Introduction to VLSI Circuits and Systems - John .P. Uyemura, JohnWiley, 2003.
3. Digital Integrated Circuits - John M. Rabaey, PHI, EEE, 1997.
4. VHDL Primer by J. Bhasker, Prentice Hall. 2006

EI 1458 **ADVANCED SENSOR AND SIGNAL PROCESSING SYSTEMS** **L T P C**
Pre-requisite- EI 1205 **3 0 0** 6

UNIT: I

Classification of instruments transducers: Input and output characteristics of various transducers, variable resistance transducer and its equivalent circuit, potentiometers, their construction and performance, variable inductance and variable capacitance transducers, their construction and performance, Piezoelectric transducer.

UNIT II

Design techniques for sensor signal conditioning: Sensor and signal conditioning for strain, force, pressure, flow and temperature measurement, Bridge configurations, Amplifying and linearising bridge outputs, Driving bridge circuits. Ratiometric techniques.

UNIT III

High impedance sensors: Photodiodes and high impedance charge output sensors, Signal conditioning of high impedance sensors

UNIT IV

Positioning, motion and temperature sensors :LVDT, Hall effect magnetic sensors, optical encoders Accelerometer, RTDs, thermistors, thermocouples, semiconductors temperature sensors and their signal conditioning

UNIT V

Micro-sensors and smart sensors: Construction , characteristics, and applications.

UNIT VI

Hardware design techniques : Grounding in mixed signal systems, Power supply noise reduction and filtering, Shielding and isolation technique, Over-voltage and Electrostatic discharge (ESD) protection techniques.

REFERNCES:

1. H.K.P Neubert "Instrument Transducers Oxford Herman University Press Eighth Impression 2008.
2. Ramon Pallas-Arenyand Johan G. Webster "Sensor And Signal Conditioning" John Wiley,
3. New York 1991.
4. Dan Sheingold-Editior "Transducer Interfacing Handbook", Analog Devices Inc 1980
5. "High Speed Design Technique" Analog Device Inc 1996
6. Jacoba Fraden "Handbook Of Modern Sensors "2nd Edition ,Springer-Verlag.New York 1996
7. Jerald G.Graeme "Photodiode Amplifiers And Op-Amp Solution", Mc Graw Hill 1995
8. Harry L. Trietly , "Transducers In Mechanical And Electronic Design", Marcel Dekker Inc 1986

ELECTIVE –V

EI 1461 **OPTO ELECTRONICS AND FIBER OPTICS** **L T P C**
Pre-requisite- None **3 0 0 6**

UNIT I :

Optical Fiber:Introduction, optical fibre, basic principle of fibre-optics, Fiber Materials , Ray Propagation in Step-Index Fibers, Total internal reflection, Ray Propagation in Graded Index Fibers, Mode Theory, Monomode fibers, Attenuation in Optical Fibers – absorption, scattering and bending losses.

Power Launching and Coupling: Source-to- Fiber Power Launching, Power-coupling calculation, Equilibrium Numerical Aperture, Lensing Schemes for coupling Improvement.

UNIT II

Fiber-Optic Sensors: Intensity Modulated Sensors, Phase Modulated Sensors, Fiber-optic Mach-Zehnder Interferometric sensor, Fiber-optic Gyroscope, Spectrally Modulated Sensors, Distributed Fiber Optic Sensors.

Optical Amplifiers: Semiconductor Optical amplifiers (SOA), Erbium Doped Fiber amplifiers.

UNIT III

Optical Sources: Light Emitting Diodes (LEDs), LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation of an LED. LASER diodes: Principle of Operation, Modes and Threshold Conditions, Optical output power and drive current, Quantum efficiency, Resonant frequencies, Radiation Pattern, Single Mode Lasers, Modulation of Laser diode. Laser based instrumentation.

UNIT IV

Optical Detectors: P-n junction Photo diodes, Power relationship , Responsivity Versus wavelength, Equivalent Circuit of a p-n Photo diode, Bandwidth, p-i-n photo diode and APD, Principle of operation, Sources of noise, Noise Equivalent Circuits , Signal to noise ratio for p-i-n and APD .

Text Books:

1. Optical Fiber Communication by Gerd Keiser, McGraw Hill International Edition.
2. Fiber Optics and Opto electronics by R. P. Khare, Oxford University Press .

Reference Book :

1. Optical Fiber Communications Principles and Practice by John M. Senior, Pearson Education.
2. Optoelectronics and Fiber Optics Communication by C.K.Sarkar and D.C Sarkar, New Age International.

EI 1462	DATA BASE MANAGEMENT SYSTEMS	L T P C
	Pre-requisite- None	3 0 0 6

UNIT I INTRODUCTION AND CONCEPTUAL MODELING

Introduction to File and Database systems- Database system structure – Data Models – Introduction to Network and Hierarchical Models – ER model – Relational Model – Relational Algebra and Calculus.

UNIT II RELATIONAL MODEL

SQL-Data definition- Queries in SQL- Updates- Views – Integrity and Security – Relational Database design – Functional dependences and Normalization for Relational Databases (up to BCNF).

UNIT III DATA STORAGE AND QUERY PROCESSING

Record storage and Primary file organization- Secondary storage Devices- Operations on Files- Heap File-Sorted Files- Hashing Techniques – Index Structure for files –Different types of Indexes- B-Tree - B+Tree – Query Processing.

UNIT IV TRANSACTION MANAGEMENT

Transaction Processing – Introduction- Need for Concurrency control- Desirable properties of Transaction- Schedule and Recoverability- Serializability and Schedules – Concurrency Control – Types of Locks- Two Phases locking- Deadlock- Time stamp based concurrency control – Recovery Techniques – Concepts-Immediate Update- Deferred Update - Shadow Paging.

UNIT V CURRENT TRENDS

Object Oriented Databases – Need for Complex Data types- OO data Model- Nested relations- Complex Types- Inheritance Reference Types - Distributed databases- Homogenous and Heterogenous- Distributed data Storage

– XML – Structure of XML- Data- XML Document- Schema- Querying and Transformation. – Data Mining and Data Warehousing.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “Database System Concepts”, Fourth Edition, McGraw-Hill.

REFERENCES

1. Ramez Elmasri and Shamkant B. Navathe, “Fundamental Database Systems”, Pearson Education.
2. Raghu Ramakrishnan, “Database Management System”, Tata McGraw-Hill Publishing Company.

3. Hector Garcia–Molina, Jeffrey D.Ullman and Jennifer Widom- "Database System Implementation"- Pearson Education.
4. Peter Rob and Corlos Coronel- "Database System, Design, Implementation and Management", Thompson Learning Course Technology.

EI 1463 DATA WAREHOUSING AND DATA MINING L T P C

Pre-requisite- None **3 0 0 6**

UNIT I

Data Warehousing – Concept of Data Warehouse, Differences between Operational Databases and Data Warehouse.

UNIT II

Multi-dimensional Data Model, Schemas for Multi-dimensional Databases, Data Cube Representations.

UNIT III

Data Warehouse Architecture, OLTP vs OLAP, Efficient Query Processing in data Warehouses, Indexing of OLAP data, Materialization concept.

UNIT IV

Data Mining – Association Rule Mining Techniques**:** Frequent Item set Generation, A priori, Horizontal Method, Sampling Approach, Hashing Approach, Dynamic Association Rule Mining;

UNIT V

Data Clustering**:** Partitioning, Hierarchical, Density-based, Grid Based and Model Based Methods; Classification & Prediction**:** Decision Tree Techniques, Bayesian Method;Mining of Complex Types of Data**:** Mining of Spatial Databases, Multimedia Databases, Text Databases, WWW Data.

Books:

1. Data Mining: Concepts and Techniques – Jiawei H., Micheline K. (Elsevier).
2. Data Mining Techniques – Pujari A.K. (University Press).

EI 1464 PETRO-CHEMICAL INSTRUMENTATION L T P C

Pre-requisite- None **3 0 0 6**

UNIT I : PETROLEUM PROCESSING

Petroleum exploration – Recovery techniques – Oil – Gas separation - Processing wet gases – Refining of crude oil.

UNIT II : OPERATIONS IN PETROLEUM INDUSTRY

Thermal cracking – Catalytic cracking – Catalytic reforming – Polymerisation – Alkylation – Isomerization – Production of ethylene, acetylene and propylene from petroleum.

UNIT III : CHEMICALS FROM PETROLEUM PRODUCTS

Chemicals from petroleum – Methane derivatives – Acetylene derivatives – Ethylene derivatives – Propylene derivatives – Other products.

UNIT IV : MEASUREMENTS IN PETROCHEMICAL INDUSTRY

Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments – Intrinsic safety of Instruments.

UNIT V: CONTROL LOOPS IN PETROCHEMICAL INDUSTRY

Process control in refinery and petrochemical industry – Control of distillation column – Control of catalytic crackers and pyrolysis unit – Automatic control of polyethylene production – Control of vinyl chloride and PVC production.

TEXT BOOKS

1. A.L. Waddams, „Chemicals from Petroleum", Butter and Janner Ltd., 1968.
2. J.G. Balchan. and K.I. Mumme, „Process Control Structures and Applications", Van Nostrand Reinhold Company, New York, 1988.

REFERENCE BOOKS

1. Austin G.T. Shreeves, „Chemical Process Industries", McGraw Hill International Student edition, Singapore
2. B.G Liptak, „Instrumentation in Process Industries", Chilton Book Company.

EI 1465	**WIND AND SOLAR ENERGY SYSTEMS**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT I:INTRODUCTION TO ENERGY SOURCES

Renewable and non-renewable energy sources, energy consumption as a measure of Nation"s development, strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources

UNIT II:SOLAR ENERGY

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaics - solar cells & its applications.

UNIT III:WIND ENERGY

Principle of wind energy conversion, Basic components of wind energy conversion systems, wind mill components, various types and their constructional features, design considerations of horizontal and vertical axis wind machines, analysis of aerodynamic forces acting on wind mill blades and estimation of power output, wind data and site selection considerations.

BOOKS:

1. G D Rai, "Solar Energy Utilization", Khanna Publishers.
2. S.P Sukhatme, "Solar Energy -Principles of Thermal Collection and Storage", Tata McGraw-Hill.
3. F Kreith, and J.F Kreider, "Principles of Solar Engineering", Mc-Graw-Hill Book Co.
4. J. F. Manwell, J. G. McGowan, A. L. Rogers, "Wind Energy Explained", John Weily & Sons Ltd,
5. S A Abbasi, "Renewable energy sources and their environmental impact", Prentice hall of India.

REFERENCE BOOKS:

1. A.Duffie and W.A.Beckmann, Solar Engineering of Thermal Processes-John Wiley .
2. F.Kreith and J.F.Kreider, Principles of Solar Engineering , McGraw-Hill.
3. T.N.Veziroglu, Alternative Energy Sources, Vol 5 and 6, McGraw-Hill.
4. E.J. Womack , "MHD power generation engineering aspects" , Chapman, Hall Publication.

EI 1466	**ADVANCED CONTROL SYSTEMS**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

INTRODUCTION TO COMPUTER – BASED CONTROL

z – transform techniques, Signal processing in digital control, Principles of signal conversion, Transfer function models for discrete time systems, System response, Stability in the z – plane and the jury stability criterion, Sampling and data reconstruction process, Principles of discrimination.

DIGITAL CONTROL DEVICES AND SYSTEMS

A/D converters, D/A converters, Shaft encoder, Z – domain description of closed loop systems, Systems with dead – time, Implementation of digital controllers.

DIGITAL COMPENSATOR DESIGN USING FREQUENCY - RESPONSE AND ROOT – LOCUS PLOTS

Z - plane synthesis, Digital controllers for deadbeat performance.

STATE VARIABLE REPRESENTATION OF DISCRETE – TIME AND CONTINUOUS TIME SYSTEMS

Solution of time invariant, time variant continuous time systems & discrete time system state equations, Concepts of controllability and observability, Equivalence between transfer function and state variable representations, Pole-placement using state variable feedback, Design of state observers,

INTRODUCTION TO NONLINEAR FEEDBACK CONTROL SYSTEMS

Describing function and phase – plane techniques, Liapunov"s stability analysis, Optimal control theorem. Adaptive control systems.

TEXT BOOKS:

1. Modern Control Systems Dorf and Bishop, PHI
2. A text book of Control System, Ogata, PHI
3. Digital Control System, B.C.Kuo, PHI

OPEN ELECTIVE – I

EI 1471	**SOFT COMPUTING TECHNIQUES FOR NON-LINEAR OPTIMIZATION**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT I

Artificial intelligence systems– Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks: Biological neural networks, model of an artificial neuron, Activation functions, architectures, characteristics-learning methods, brief history of ANN research-Early ANN architectures (basics only)- McCulloch & Pitts model, Perceptron, ADALINE, MADALINE

UNIT II

Back-propagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, hidden layer, output layer computations, calculation of error, training of ANN, BP algorithm, momentum and learning rate, Selection of various parameters in BP networks.

Variations in standard BP algorithms- Adaptive learning rate BP, resilient BP, Levenberg-Marquardt, and conjugate gradient BP algorithms (basic principle only)- Applications of ANN

UNIT III

Fuzzy Logic–Crisp & fuzzy sets – fuzzy relations – fuzzy conditional statements – fuzzy rules – fuzzy algorithm. Fuzzy logic controller – fuzzification interface – knowledge base – decision making logic – defuzzification interface – design of fuzzy logic controller –case studies.

UNIT IV

Genetic algorithms – basic concepts, encoding, fitness function, reproduction-Roulette wheel,

Boltzmann, tournament, rank, and steady state selections, Elitism. Inheritance operators, Crossoverdifferent types, Mutation, Bit-wise operators, Generational cycle, Convergence of GA, Applications of GA – case studies. Introduction to genetic programming- basic concepts.

Text Books

1. R. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications,* Prentice Hall of India, New Delhi, 2003.
2. L. Fausett, *Fundamentals of Neural Networks*, Prentice Hall, Upper Saddle River, N.J, 1994.

Reference Books

1. D. E. Goldberg, *Genetic Algorithms in Search, Optimization, and Machine Learning*, Addison- Wesley, Reading, MA, 1989.
2. M. T. Hagan, H. B. Demuth, and M. H. Beale, *Neural Network Design*, PWS Publishing, Boston, MA, 1996.
3. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill, New Delhi, 1995.
4. J. R. Koza, *Genetic Programming: On the Programming of Computers by Natural Selection*, MIT Press, Cambridge, 1992.
5. B. Yegnanarayana, *Artificial Neural Networks*. Prentice Hall of India, New Delhi, 1999.

EI 1472	**SMART SENSORS**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT - I

BASICS OF SMART SENSORS & MICROMACHINING: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques.

UNIT - II

SENSOR INFORMATION TO MCU: Introduction, amplification and signal conditioning, separate versus integrated signal conditioning, digital conversion.

UNIT - III

MCUS AND DSPS TO INCREASE SENSOR IQ: Introduction, MCU control, MCUs for sensor interface, DSP control, Software, tools and support, sensor integration.

UNIT - IV

COMMUNICATIONS FOR SMART SENSORS : Introduction, definitions and background, sources and standards, automotive protocols, industrial networks, office & building automation, home automation, protocols in silicon, other aspects of network communications.

UNIT - V

CONTROL TECHNIQUES: Introduction, state machines, fuzzy logic, neural networks, combined fuzzy logic and neural networks, adaptive control, other control areas.

UNIT - VI

SENSOR COMMUNICATION & MEMS: Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Microoptics, microgrippers, microprobes, micromirrors, FEDs.

UNIT - VII

PACKAGING, TESTING AND RELIABILITY OF SMART SENSORS: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors. Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.

UNIT - VIII

IMPLICATIONS OF SMART SENSOR STANDARDS AND RECENT TRENDS: Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.

TEXT BOOKS:

1. Smart Sensors and Sensing Technology, Daniel E. Suarez,Nova Science Publishers

REFERENCE: IEEE Smart Sensors (www.ieee.org/xplore)

EI 1473 EVOLUTIONARY ALGORITHMS IN SEARCH AND OPTIMIZATION L T P C

Pre-requisite- Non **3 0 0 6**

UNIT I : INTRODUCTION

Introduction to concept of intelligent agents and different views of artificial intelligence and the nature of intelligence itself; early history of AI (e.g. Newell/Simon GPS, McCarthy's advice-taker); the Turing test and its influence on AI.

UNIT II : PROBLEM-SOLVING AND SEARCH

Expressing problem-solving as a search through solution space and how to match problem "structure" to appropriate search techniques. Different problem types and appropriate algorithms and their performance (worst-case time, space, optimality and completeness): Uninformed Search (BFS, DFS, ID), Informed Search (A*, admissible heuristics, IDA); Local search and optimization (hill-climbing, simulated annealing, genetic algorithms); Constraint Satisfaction Problems (backtracking vs conflict minimization methods.

UNIT III : LOGICAL REASONING

Expressing intelligence as the ability to query a knowledge base, by using logic and inference as the implementation; Two different logics types and algorithms for efficient inference: Propositional logic (syntax and rules, inference algorithms using resolution and CSP techniques, definite clauses and linear-time inference); First-order logic (comparison to propositional logic, inference algorithms e.g. forward-backward chaining and resolution with set-of-support); Discuss applications both within and outside AI (e.g. hardware verification, natural language interfaces, SOAR) and logic-based languages (e.g. prolog).

UNIT IV : PLANNING AHEAD

Automated Planning as combining concepts of search and logic; STRIPs planning language; Total-order planning and Partial-Order Planning and algorithms for generating such plans; planning using GraphPlan; Exposure to temporal logic and scheduling algorithms; Applications (e.g. Deep Space I autonomous control)

UNIT V : EMBODIMENT

Embodied intelligence or Autonomous robotics; Two approaches Shakeyvs Behavior-based Robotics; search and planning applied to Robotics; Multi-robot systems and coordination; Applications (roomba, robocup, darpa urban challenge)

Text books:

1. Daniel Ashlock, Evolutionary Computation for Modeling and Optimization, 2005
2. Thomas Weise, Global Optimization Algorithms: Theory and Application, 2009

References:

1. Gusz Eiben and Jim Smith, “Introduction to Evolutionary Computing”, 2007
2. Andries Engelbrecht, Computational Intelligence: An Introduction, 2007
3. Kenneth DeJong, Evolutionary Computation A Unified Approach, 2006

EI 1474 MODERN ANALYTICAL INSTRUMENTS L T P C

Pre-requisite- None **3 0 0 6**

UNIT I : COLORIMETRY AND SPECTROPHOTOMETRY

Special methods of analysis – Beer-Lambert law – Colorimeters – UV-Vis spectrophotometers –Single and double beam instruments – Sources and detectors – IR spectrophotometers – Types–Attenuated total reflectance flame photometers – Atomic absorption spectrophotometers – Sources and detectors – FTIR spectrophotometers – Flame emission photometers.

UNIT II : CHROMATOGRAPHY

Different techniques – Gas chromatography – Detectors – Liquid chromatographs – Applications –High-pressure liquid chromatographs – Applications.

UNIT III : INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS

Types of gas analyzers – Oxygen, NO2 and H2S types, IR analyzers – Thermal conductivity analyzers – Analysis based on ionization of gases – Air pollution due to carbon monoxide, hydrocarbons – Nitrogen oxides – Sulphur-dioxide estimation – Dust and smoke measurements.

UNIT IV : pH METERS AND DISSOLVED COMPONENT ANALYZERS

Principle of pH measurement – Glass electrodes – Hydrogen electrodes – Reference electrodes,selective ion electrodes and ammonia electrodes – Biosensors – Dissolved oxygen analyzer –Sodium analyzer – Silicon analyzer.

UNIT V : RADIO CHEMICAL AND MAGNETIC RESONANCE TECHNIQUES

Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors –Gamma cameras – X-ray spectroscopy – Detectors – Diffractometers – Absorption meters –Detectors – NMR – Basic principles – NMR spectrometer – Applications – Mass spectrometers –Different types – Applications.

TEXT BOOKS:

1. R.S. Khandpur, “Handbook of Analytical Instruments”, Tata McGraw Hill.
2. H.H. Willard, L.L. Merritt, J.A. Dean, and F.A. Settle,“Instrumental Methods of Analysis”,CBS Publishing and Distribution.

REFERENCES

1. R. D. Braun, “Introduction to Instrumental Analysis”, McGraw Hill.
2. G.W. Ewing, “Instrumental Methods of Analysis”, McGraw Hill.
3. D.A. Skoog, and D.M. West, “Principles of Instrumental Analysis”, Saunders Publishing.
4. C.K. Mann, T.J. Vickers and W.H. Gullick, “Instrumental Analysis”, Harper and Row Publishers.

EI 1475	**INDUSTRIAL AUTOMATION**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT I

Control Systems and Automation Strategy:
Evolution of instrumentation and control, Role of automation in industries, Benefits of automation, Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC, Automation strategy evolution, Control system audit, performance criteria, Safety Systems.

UNIT II

Programmable logic controllers (PLC): Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, PLC design, Study of industrial PLC.

UNIT III

Advance Applications of PLC and SCADA: PLC programming methods as per IEC 61131, PLC applications for batch process using SFC, Analog Control using PLC, PLC interface to SCADA/DCS using communication links (RS232, RS485) and protocols (Modbus ASCII/RTU).

UNIT IV

Instrumentation Standard Protocols: HART Protocol introduction, frame structure, programming, implementation examples, Benefits, Advantages and Limitations.
Foundation Fieldbus H1 introduction, structure, programming, FDS configuration, implementation examples, Benefits, Advantages and Limitations, Comparison with other fieldbus standards including Device net, Profibus, Controlnet, CAN, Industrial Ethernet etc.

UNIT V

Distributed Control Systems: DCS introduction, functions, advantages and limitations, DCS as an automation tool to support Enterprise Resources Planning, DCS Architecture of different makes,specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc.

Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC support, Security and Access Control etc.

UNIT VI

Automation for following industries – Power, Water and Waste Water Treatment, Food and Beverages, Cement, Pharmaceuticals, Automobile and Building Automation

Text Books:

1. Distributed Computer Control for Industrial Automation by Poppovik Bhatkar, Dekkar Publications
2. Programmable Logic Controllers: Principles and Applications by Webb and Reis PHI
3. Computer Aided Process Control, by S.K.Singh PHI

Reference books:

1. Introduction to Programmable Logic Controllers, by Garry Dunning Thomson Learning.
2. The Management of Control System: Justification and Technical Auditing N.E.Battikha ISA
3. Computer Based Process Control Krishna Kant PH

EI 1476	**MOBILE ADHOC AND SENSOR NETWORKS**	**L T P C**
	Pre-requisite- Non	**3 0 0 6**

UNIT I

Introduction- Adhoc networks. Mobile Ad-Hoc networking with a View of 4G Wireless, Off-the-Shelf Enables of Ad Hoc, IEEE 802.11 in Ad Hoc Networks:

UNIT II

Protocols, Performance and Open Issues, Scatternet Formation in Bluetooth Networks , Antenna Beam forming and Power Control for Ad Hoc Networks, Topology Control in Wireless Ad Hoc Networks, Broadcasting and Activity Scheduling in Ad Hoc Networks.

UNIT III

Location Discovery, Routing Approaches in Mobile Ad Hoc Networks, Energy-Efficient Communication in Ad Hoc Wireless, Ad Hoc Networks Security, Self-Organized and Cooperative Ad Hoc Networking.

UNIT IV

Simulation and Modeling of Wireless, Mobile, and Ad Hoc Networks, Modeling Cross-Layering Interaction Using Inverse Optimization Algorithmic Challenges in Ad Hoc Networks

UNIT V: Sensor Networks

Introduction to sensor network, Unique constraints and challenges, Localization and Tracking, Networking Sensors, Infrastructure establishment, Sensor Tasking and Control, Sensor network databases, Sensor Network Platforms and tools, Industrial Applications and Research directions.

Books:

1. Mobile Adhoc Networks – Aggelou , George (McGraw-Hill).
2. Mobile Adhoc Networking – Stefano Basagni (Editor), Marco Conti (Editor), Silvia Giordano (Editor), Ivan Stojmenovi & Cacute (Editor) (Wiley-IEEE Press).
3. The course mainly based on contemporary research on sensor network and ubiquitous computing. Papers from leading journals need to be consulted.
4. Wireless Sensor Networks: An Information Processing Approach – Feng Zhao, Leonidas Guibas (Elsevier).
5. Handbook of Sensor Networks: Algorithms and Architectures – Ivan Stojmenovi & Cacute (Wiley).

(The course mainly based on contemporary research on sensor network and ubiquitous computing. Papers from leading journals need to be consulted.)

OPEN ELECTIVE-II

EI 1481 **OPTIMIZATION METHODS IN ENGINEERING** **L T P C**
Pre-requisite- Non **3 0 0 6**

UNIT I :

Introduction to Optimization –statement of optimization problems, engineering applications-classical optimization techniques-single and multivariable objective function with and without constraints.

UNIT II:

Linear Programming: Graphical method, Simplex method, Revised simplex method, Duality in linear programming (LP), Sensitivity analysis, other algorithms for solving LP problems, transportation, assignment and other applications

UNIT III

Non-linear programming- one dimensional search, unconstrained optimization tech-gradient approach, steepest descent method, constrained problem- penalty function method, Lagrangian method.

UNIT IV

Dynamic programming- multistage decision process, principle of optimality, computational procedure in Dynamic programming.

UNIT V

Further topics in optimization- Queuing theory, Game theory optimal control theory, calculus of variation, multi-objective optimization, Introduction to genetic algorithm, Case Studies.

Text Books:

1. Kanti Swarup, Gupta,P.K and Man Mohan, "*Operation Research*", Sultan Chand, 11th Edition, 2003.
2. Rao,S.S., "*Optimization: Theory and Applications*", Wiley Eastern.
3. David E. Goldberg, "*Genetic Algorithms in Search, Optimization & Machine Learning* ", Addison Wesley Publishing Company, Inc.

EI 1482 **MACHINE INTELLIGENCE** **L T P C**
Pre-requisite- None **3 0 0 6**

UNIT I: KNOWLEDGE REPRESENTATION:

The First Order Predicate Logic, Production Systems, Semantic Nets, Frames and Scripts Formalisms. Resolution in Predicate Logic, Unification, Strategies for Resolution by Refutation. Knowledge Acquisition and learning: Learning from examples and analogy, Rote learning, Neural Learning, Integrated Approach. Planning and Robotics: STRIPS, ABSTRIPS, NOAH and MOLGEN planners, preliminary ideas of distributed and real time planning, Subsumption architecture based planning.

UNIT II: EXPERT SYSTEMS:

Fundamental blocks, case studies in various domains, concept of shells, connectionist expert systems. Introduction to Natural Language Understanding: problems of ambiguity, ellipsis and polysemy, lexicalization and parsing, Transition and Augmented Transition networks, Natural Language Interfaces. Introdution to Computer Vision: Edge detection, Point Correspondence and Stereopsis, Surface directions. Basics of Neural Networks: Perceptrons, Feedforward nets Backpropagation algorithm, preliminary understanding of unsupervised learning, Learning Decision Trees.

Text/Reference books:

1.Introduction to Artificial Intelligence E. Charniak, et.al Addison Wesley 2.Artificial Intelligence P. H. Winston Addison Wesley

3.Artificial Intelligence E. Rich and K. Knight Addison Wesley

4.Artificial Intelligence and Neural Networks R. Honavar and E. Uhr Academic

Press 5.Building Expert Systems F. Hayes Roth et.al. Addison Wesley
6.The Handbook of Artificial Intelligence,Vol.1,2 and 3
6. J. Carbonell, Machine Learning paradigms and Methods, MIT Press,

EI 1483 HUMAN COMPUTER INTERFACES

	L	T	P	C
Pre-requisite- None	3	0	0	6

UNIT I : **INTRODUCTION:**

Importance of user Interface – Definition, Importance of good design, Benefits of good design, A brief history of Screen design.

UNIT II: THE GRAPHICAL USER INTERFACE:

Popularity of graphics, The concept of direct manipulation, Graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT III: DESIGN PROCESS:

Human interaction with computers, Importance of human characteristics human consideration, Human interaction speeds, Understanding business junctions.

UNIT IV: SCREEN DESIGNING:

Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT V: WINDOWS:

New and Navigation schemes selection of window, selection of devices based and screen based controls.

Components:

Text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

Software tools:

Specification methods, interface – Building Tools.

Interaction Devices:

Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers- BCI and its applications.

Text Books:

1. The essential guide to user interface design Wilbert O Galitz Wiley DreamTech
2. Designing the user interface. 3rd Edition Ben Shneidermann Pearson Education, Asia

Reference Books:

1. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.

EI 1484 MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

	L	T	P	C
Pre-requisite- Non	3	0	0	6

UNIT I: INTRODUCTION TO MEMS

MEMS and Microsystems:- Miniaturization and Typical products – Micro Sensors, Micro actuation - MEMS with micro actuators - Microaccelorometers and Micro fluidics - MEMS materials - Microfabrication.

UNIT II: **MECHANICS FOR MEMS DESIGN**

Elasticity, stress, strain and material properties, Bending of thin plates, Spring configurations,torsional deflection, Mechanical vibration, Resonance – Thermo mechanics – Actuators, force and response time, Fracture and thin film mechanics, material, Physical Vapor Deposition (PVD), Chemical Mechanical Polishing (CMP).

UNIT III: ELECTROSTATIC DESIGN

Electrostatics:- basic theory, electro static instability, Surface tension, gap and finger pull up - Electro static actuators - Comb generators - Gap closers - Rotary motors - Inch worms - Electromagnetic actuators - Bistable actuators.

UNIT IV: CIRCUIT MODELING OF MEMS

Circuit modeling of MEMS:- Resonator equivalent circuit, Thermal Circuits and Fluidic Circuits –Signal Conditioning Circuits:- Op-Amp models and Circuits, transistor level-design – Electronic and Mechanical Noise:- Electronic noise sources, Brownian motion noise, circuit noise calculation procedure, SNR and dynamic range.

UNIT V: CASE STUDIES

Microbridge gas sensors – Piezoelectric rate gyroscope – Capacitive Accelerometer – Piezoresistive Pressure Sensor – Thermal Sensors:- Radiation Sensors, Mechanical Sensors and Bio-Chemical Sensors.

TEXT BOOK:

1. Santeria, S., "Microsystems Design", Kluwer publishers.
2. Hsu, T.R., "MEMS and Micro systems Design and Manufacture" Tata McGraw- Hill, New Delhi.

REFERENCES:

1. Maluf, N., "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Gad-el-Hak, M., "The MEMS Handbook", CRC press Baco Raton, 2000..
3. Gardner, J.W., Vijay k. varadan, V.K. and Osama O.Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley and son LTD, 2002.
4. Allen, J.J., "Micro Electro Mechanical System Design", CRC Press published in 2005.

EI 1485	**NEURAL NETWORKS AND FUZZY LOGIC**	**L T P C**
	Pre-requisite- None	**3 0 0 6**

UNIT I :INTRODUCTION

Introduction and different architectures of neural networks- Artifical neuron – MLP- Backpropagation – Hopefield networks – Kohonen self organization maps – adaptive resonance theory.

UNIT II: NEURAL NETWORKS FOR CONTROL

Schemes of neuro – control – identification and control of dynamical systems – adaptive neuro controller – case study.

UNIT III: FUZZY LOGIC

Introduction- Fuzzy sets – fuzzy relations – fuzzy conditional statements – fuzzy rules – fuzzy algorithm.

UNIT IV: FUZZY LOGIC CONTROL SYSTEM

Fuzzy logic controller – fuzzification interface – knowledge base – decision making logic – defuzzification interface – design of fuzzy logic controller – case study

UNIT V: NEURO – FUZZY LOGIC CONTROL

Optimisation of membership function and rules base of fuzzy logic controller using neural networks – genetic algorithm
– fuzzy neuron – adaptive fuzzy systems – case study.

TEXT BOOKS

1. Laurance Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood cliffs, N.J, 1992.
2. H.J Zimmermann, "Fuzzy set theory and its applications", Allied Publication Ltd.

REFERENCES:

1. L.H Tsoukalas, and E.Uhrig , "Robert, Fuzzy and Neural approach in Engineering", John Wiley and Sons.
2. M.Zurada Jacek, " Introduction to artificial Neural Systems", Jaico Publishing House, Mumbai.
3. G.J Klir.and B.B Yuan, "Fuzzy sets and fuzzy logic", Prentice Hall of India, New Delhi.
4. D Driankov, H Hellendron, M Reinfrank., "An Introduction to Fuzzy control", Narosa publishing House, New Delhi.
5. W.T. Millon, R.S. Sutton and P.J. Webrose, " Neural Networks for control", MIT Press.

EI 1486 **BIOMEDICAL ENGINEERING** **L T P C**

Pre-requisite- Non **3 0 0 6**

UNIT I

Physiological systems and Signals: Biology of the heart, circulatory and respiratory systems, auditory systems, physiology of nerve and muscle cells, fundamental organization of brain and spinal cord.

Biosignals: Origin of bioelectric signals, electrocardiogram (ECG), phonocardiogram (PCG), encephalogram (EEG) and electromyogram (EMG), spectral characteristic of biosignals.

UNIT II

Physiological Transducers: Electrodes: silver-silver chloride electrodes, electrodes for ECG, EEG, EMG, Microelectrodes. Performance characteristics of transducers, classification of transducers based on Electrical principle involved: Resistive position transducer, resistive pressure transducer, inductive pressure transducer, capacitive pressure transducer; Self generating inductive transducer: linear variable differential transformer (LVDT), Piezoelectric Transducer.

Transducers for body temp measurement, photoelectric transducers, pH measurement. Ion-exchange membrane electrodes, enzyme electrode, glucose sensors, immune-sensors. Basic principles of MOSFET biosensors & BIOMEMS.

UNIT III

Recording Systems: Preamplifier, Signal conditioning: Differential amplifier, current to voltage converter, instrumentation amplifier; biomedical filters: LPF, HPF, bandpass, band stop (Notch filter); 4-20ma transmitter, source of noise in low level measurement, Recording systems for ECG, PCG, EEG and EMG.

UNIT IV

Medical Imaging Systems: X-ray imaging, Computed tomography, ultrasonic imaging systems, Magnetic resonance imaging system, thermal imaging systems.

UNIT V

Therapeutic equipments: Cardiac pacemaker, cardiac defibrillators, haemodylysis machine, lithotisptors, ventilators, bionic ear.

Patient monitoring systems: Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques

Text Books:

1. L. Cromwell, F. J. Weibell, E.A. Pfeiffer. „Biomedical Instrumentation and Measurement", Pearson Education, 2003
2. R.S. Khandpur, „Handbook of Biomedical Instrumentation", TATA Mc-GRAW HILL

Reference Book:

1. J. Enderle, S. Blanchard, J. Bronzino. „Introduction to Biomedical Engineering", Academic Press

EI 1487 INDUSTRIAL PIPING AND INSTRUMENTATION DIAGRAMS L T P C

Pre-requisite- None **3 0 0 6**

Introduction- Significance of piping- Industry oriented piping-P&I Diagram objectives. Industry Codes and Standards. Government regulations.

Piping basics and fundamentals :
Introduction to piping, Evolution of piping, Manufacturing methods, Piping materials and selection, Pipe dimensioning, Schedule numbers, Common piping abbreviations, Major organizations for standards, Commonly American code in piping ASME/ANSI, Common abbreviations.

Piping components :
Fittings - elbows, weld tee, stub in, couplings, reducers, weld cap, screwed and socket welded fittings, Pipe nipples, flanged fittings and use of fittings. Flange -Types, P-T ratings and facings. Gaskets, bolts and nuts. Valves - Types, operations, applicability, codes and specifications.

Process plant equipments/ mechanical equipments :
Horizontal vessels/accumulators, fractionation columns, pumps, heat exchangers, re-boiler, air cooled heat exchanger, cooling towers, heaters/boilers, storage tanks, fractional distillation process and vendor data drawings.

Flow diagrams& instrumentation/ pipe routing concepts :
Uses of flow diagrams, process flow diagrams, mechanical flow diagrams, utility flow diagrams, piping symbols, line symbols, valve symbols, piping isometrics, general arrangement drawings- sections/elevations/ detail drawings, plot plan procedures.
Electrical Diagrams, Electronic diagrams, Logic diagrams. DCS diagrams, Construction diagrams.
Format. Equipment. Instrumentation and Controls. Applications of P&I diagrams in HAZOPS and Risk analysis.

Process & instrumentation diagrams (P&ID)/ process flow diagram (PFD) :
Purpose of P&ID‟S, study of P&ID‟S, stages of development of P&ID‟S, process and instrumentation diagrams, process equipments, symbols usage according to industrial practices. Purpose of P&ID in process industrial/plants.

ASME/ANSI codes and specifications : ASME/ANSI Codes & Specification, Specification classes, Piping abbreviations, General abbreviations.

Equipment layout drawings : Plant Co-ordinate Systems, Site Plans, Unit Plot Plan, Equipment Location Drawing, Foundation Location Drawing.

Standard piping details/ piping system : Pipe Rack Spacing, Drawing pipe in the rack, pipe insulation shoes, pipe guides, field supports, dummy supports, hanger rods, spring hangers, pick-up pipe supports, plant utilities, control valve manifolds, utility stations, sewer and underground piping system.
[Laboratory: Students are required to practice & produce P&I diagrams using software packages in laboratory during the period of the course.]

References:

1. *Industry Codes and Standards*
2. American National Standards Institute (ANSI) - ANSI/FCI 70-2-2003 - Control Valve Seat Leakage
3. American Society of Mechanical Engineers (ASME) - ASME Boiler and Pressure Vessel Code. Section VIII - Pressure Vessels
4. The Instrumentation, Systems and Automation Society (ISA)
5. ISA 5.1 - Instrumentation Symbols and Identification
6. ISA 5.2 - Binary Logic Diagrams for Process Operations
7. ISA 5.3 - Graphic Symbols for Distributed Control/ Shared Display *Instrumentation, Logic and Computer Systems*
8. ISA 84.01 - Application of Safety Instrumented Systems for the Process Industries
9. Tubular Exchanger Manufacturers Association (TEMA) - TEMA Standards
10. *Government Regulations*
11. Occupational Safety and Health Administration (OSHA) - OSHA 29 CFR 1910.119 - Occupational Safety and Health Standards, Process Safety Management of Highly Hazardous Chemicals.

EI 1488	ANALOG INTEGRATED CIRCUIT DESIGN	L	T	P	C
	Pre-requisite- None	3	0	0	6

UNIT I

Introduction to Analog IC Design, Analog IC Design flow. MOSFET basics, Single stage MOS amplifiers – CS, CG, Source follower, frequency response.

UNIT II

Current mirrors, Biasing and references, Constant voltage and current references, Voltage regulator.

UNIT III

CMOS Differential pair, Two-stage CMOS Op-amp and compensation, Telescopic and Folded cascode Op-amp, Fully differential op-amp, Common-mode feedback, Noise and linearity analysis, Dynamic range.

UNIT IV

CMOS comparator, Basics of Switched capacitor circuits, Voltage controlled oscillator (VCO), Phase locked loop (PLL).

TEXT BOOKS

1. P.E. Allen and D.R.Holberg; CMOS Analog Circuit Design; Oxford University Press, 2004.
2. R.J.Baker, H. W. Li, D. E. Boyce; CMOS Circuit Design, Layout, and Simulation; PHI, 2002.
3. P.R.Gray, P.J.Hurst, S.H.Lewis and R.G.Meye; Analysis and Design of Analog Integrated Circuits, John Wiley & Sons, Fourth Edition, 2003.

REFERENCE BOOKS

1. R. L. Geiger, P. E. Allen and N. R. Strader, *VLSI Design Techniques for Analog and Digital Circuits*, McGraw-Hill, 1990.
2. D.A. Johns and K. Martin; *Analog Integrated Circuit Design*; John Wiley and Sons, 2004.
3. B. Raza; *Design of Analog CMOS Integrated Circuits*; Tata McGraw-Hill, 2002
4. Microelectronics Circuits, 5th Edn., International Student Edn. Sedraand Smith,Oxford Univ. Press, New Delhi.

Course Structure for B Tech (4 Year, 8 Semester Course) Mechanical Engineering

(to be applicable from 2012 entry batch onwards)

Course No	Course Name	L	T	P	C
Semester-1					
CH-1101 /PH-1101	Chemistry/Physics	3	1	0	8
EE-1101	Basic Electrical Engineering	3	0	0	6
MA-1101	Mathematics-I	3	1	0	8
CE-1101	Engineering Graphics	1	0	3	5
HS-1101	Communication Skills	3	0	0	6
CH-1111 /PH-1111	Chemistry/Physics laboratory	0	0	2	2
ME-1111	Workshop	0	0	3	3
	Physical Training-I	0	0	2	0
	NCC/NSO/NSS	0	0	2	0
		13	**2**	**8**	**38**
Semester-3					
MA 1201	Mathematics-III	3	1	0	8
ME 1201	Thermodynamics – I	3	1	0	8
ME 1202	Theory of Mechanisms and Machines	3	1	0	8
ME 1203	Manufacturing Process-I	3	0	0	6
ME 1204	Material Science	3	0	0	6
ME 1205	Machine Drawing	1	0	2	4
	Physical Training-III	0	0	2	0
	NCC/NCO/NSS	0	0	2	0
		16	**3**	**2**	**40**
Semester-5					
ME 1301	Dynamics and Control of machinery	3	1	0	8
ME 1302	Fluid Mechanics-II	3	1	0	8
ME 1303	Manufacturing Process-II	3	0	0	6
ME 1304	Machine Design-I	3	0	0	6
HS 1301	Business Management	3	0	0	6
ME 1311	ME Lab-II	0	0	3	3
ME 1312	ME Lab-III	0	0	3	3
		15	**2**	**6**	**40**
Semester-7					
ME 1401	Industrial Engineering and Operation Research	3	0	0	6
ME 1402	Power Plant Engg.	3	0	0	6
ME14XX	Dept. Elective-I	3	0	0	6
ME14XX	Dept. Elective-II	3	0	0	6
XX14XX	Open Elective-I	3	0	0	6
ME 1411	ME Lab-V	0	0	2	2
ME 1490	Project-I	0	0	8	8
		15	**0**	**10**	**40**

Course No	Course Name	L	T	P	C
Semester-2					
EC-1101	Basic Electronics	3	0	0	6
CS-1101	Introduction to Computing	3	0	0	6
MA-1102	Mathematics-II	3	1	0	8
ME-1101	Engineering Mechanics	3	1	0	8
PH-1101/ CH-1101	Physics/Chemistry	3	1	0	8
CS-1111	Computing Laboratory	0	0	2	2
EE-1111	Electrical Science Laboratory	0	0	2	2
PH-1111/ CH-1111	Physics/Chemistry Laboratory	0	0	2	2
	Physical Training –II	0	0	2	0
	NCC/NSO/NSS	0	0	2	0
		15	**3**	**6**	**42**
Semester-4					
ME 1206	Thermodynamics-II	3	1	0	8
ME 1207	Fluid Mechanics-I	3	1	0	8
ME 1208	Instrumentation and Measurement	3	1	0	8
ME 1209	Mechanics of Solids	3	1	0	8
HS 1201	Managerial Economics	3	0	0	6
ME 1211	ME Lab-I	0	0	2	2
	Physical Training-III	0	0	2	0
	NCC/NCO/NSS	0	0	2	0
		15	**4**	**2**	**40**
Semester-6					
ME 1305	Automobile Engineering	3	1	0	8
ME 1306	Turbo Machinery	3	1	0	8
ME 1307	Advanced Manufacturing Process	3	0	0	6
ME 1308	Machine Design-II	3	0	0	6
ME 1309	Heat Transfer	3	0	0	6
ME 1313	Workshop Practice	0	0	3	3
ME 1314	ME Lab-IV	0	0	3	3
		15	**2**	**6**	**40**
Semester-8					
ME 1403	Computer Aided Design & Manufacturing	3	0	0	6
ME 14XX	Dept. Elective-III	3	0	0	6
ME 14XX	Dept. Elective-IV	3	0	0	6
ME 14XX	Dept. Elective-V	3	0	0	6
XX 14XX	Open Elective-II	3	0	0	6
ME 1491	Projects-II	0	0	10	10
		15	**0**	**10**	**40**

NB: Industrial Training after Sixth Semester for a period of 4-6 weeks as an audit course

LIST OF ELECTIVES -

7th Semester Electives

DEPARTMENTAL ELECTIVE – I

Code	Course
ME 1421	Refrigeration
ME 1422	Principles of Combustion
ME 1423	Advanced Solid Mechanics
ME 1424	Fundamentals of Industrial Design
ME 1425	Production Management
ME 1426	Numerical Control of Machine Tools
ME 1427	Engineering Inspection and Quality Control

DEPARTMENTAL ELECTIVE – II

Code	Course
ME 1431	IC Engines
ME 1432	Gas Dynamics
ME 1433	Robotics and Robot Applications
ME 1434	Holistic Approach to Engineering Design
ME 1435	Metal Forming and Metal Cutting Technology
ME 1436	Mechanics of Composite Materials
ME 1437	Advanced Fluid Mechanics

OPEN ELECTIVE – I
(Offered by Mech. Engg. Deptt.)

Code	Course
ME 1471	Finite Element Method
ME 1472	Project Management
ME 1473	Reliability Engineering
ME 1474	Environmental Pollution and its Control
ME 1475	Mechatronics

8th Semester Electives

DEPARTMENTAL ELECTIVE - III

Code	Course
ME 1441	Diagnostic Maintenance of Mechanical Equipments
ME 1442	Mechanical Vibrations
ME 1443	Compressor and Gas Turbines
ME 1444	Convective Heat and Mass Transfer
ME 1445	Production Processes
ME 1446	Total Quality Management
ME 1447	Experimental Stress Analysis

DEPARTMENTAL ELECTIVE - IV

Code	Course
ME 1451	Computational Fluid dynamics
ME 1452	Energy Engineering and Management
ME 1453	Advanced Machining Processes
ME 1454	Air Conditioning
ME 1455	Design of Mechanical Systems
ME 1456	Tribology
ME 1457	Material Handling Systems

DEPARTMENTAL ELECTIVE - V

Code	Course
ME 1461	Non-conventional Energy
ME 1462	Viscous Fluid Flow
ME 1463	Advanced Refrigeration Systems
ME 1464	Metal Cutting and Cutting Tool design
ME 1465	Theory of Elasticity and Plasticity
ME 1466	Air Conditioning System Design
ME 1467	Rapid Prototyping

OPEN ELECTIVE – II
(Offered by Mech. Engg. Deptt.)

Code	Course
ME 1481	Entrepreneurship Development
ME 1482	Hydraulic Machines
ME 1483	Solar Architecture
ME 1484	Introduction to Optimum Design
ME 1485	MEMS and Nano-Technology
ME 1486	Foundation Skills in Integrated Product Development (FSIPD)
ME 1487	Off-Highway Vehicle Engineering

ME 1111 **WORKSHOP** **L T P C**

First Semester **0 0 3 3**

(All Branch)

Pre-requisite - Nil

General safety precautions in workshop and introduction.
Carpentry Shop: Safety precaution, Kinds of wood and timber, Application of timber as per their classification, Carpentry hand tools and machines, Demonstration of wood working machine like, band saw, circular saw, thickness planner, wood working lathe, surface planners etc.
Exercise : Different types of carpentry joint.
Smithy Shop: Safety precaution, Different types of forging tools, Study of furnace, Operation in Smithy shop.
Exercise: A simple job on Smithy.
Welding Shop: Safety precaution in welding shop, Introduction to gas and arc welding, Soldering and brazing etc. Welding equipment and welding material.
Exercise: A simple job on gas/arc welding.
Fitting Shop: Safety precaution, Introduction to fitting shop tools, equipment, Operation and their uses, Marking and measuring practice.
Exercise : A simple job using fitting tools and equipments.
Machine Shop: Safety precautions, Demonstration and working principles of some of the general machines, like lathe, shaper, milling, drilling , grinding, slotting etc., General idea of cutting tools of the machines.
Exercise : A simple job on lathe/ shaper.

Texts/Reference:

1. S K Hajra Choudhury, S K Bose, A K Hajra Choudhury, Nirjhar Roy: Workshop Technology Vol I & II; Media Promoters & Publishers Pvt. Ltd.
2. B S Raghuwanshi: A Course in Workshop Technology Vol I & II: Dhanpat Rai & Co.
3. H S Bawa: Workshop Technology Vol I & II; TMH

ME 1101 **ENGINEERING MECHANICS** L T P C

Second Semester 3 1 0 8

(All Branch)

Pre-requisite-PH 1101, MA 1101

PART – I : STATICS

Statics of rigid bodies: Classification of force systems- principle of transmissibility of a force Composition and resolution- Resultant of a coplanar force systems and conditions of equilibrium, free body diagrams. Moment of a force, couple, properties of couple- Varignon's theorem
Beams: Types of loading, Support reactions of simply supported and overhanging beams under different types of loading.
Concurrent and parallel forces in space, conditions of equilibrium.
Friction Laws of friction-angle of friction- cone of friction- ladder friction- wedge friction.
Properties of surfaces: centroid of simple and composite areas- Theorems of Pappus – Guldin. Moment of inertia of areas, Parallel and perpendicular axes theorems- Radius of Gyration, moment of inertia of simple and composite areas.
Plane Truss: Statically determinate trusses; Analysis of a truss - method of joints, method of section.
Virtual Work: Degree of freedom, Virtual displacement and virtual work; Principle of virtual work.

PART–II : DYNAMICS

Kinematics of Particles: Differential equations of kinematics – rectilinear and curvilinear motions; Cartesian co-ordinate system; Normal and tangent co-ordinate system, projectile motion.
Kinetics of Particles: Equation of motion , D'Alemberts Principle, Work , energy and power, Principle of impulse and momentum.
Impact: Direct and oblique impact.
Rotation of Rigid Bodies: Moment of inertia of material bodies, Kinematics and Kinetics of rotation- equation of motion, Principle of work and energy; Principle of impulse and momentum.
Plane motion of Rigid Bodies: Translation of a rigid body in a plane; Kinematics of plane motion; Instantaneous center of rotation; Kinetics of plane motion – equation of motion , principle of work and energy; Principle of impulse and momentum.

Texts/Reference:

1. K. L. Kumar: Engineering Mechanics: Tata McGraw Hill
2. J.L.Meriam & L.G.Kraige: Engineering Mechanics -Statics & Dynamics: John Wiley&Sons,Inc
3. F. P. Beer & E. R. Johnston: Vector Mechanics for Engineers- Statics & Dynamics: Tata McGraw Hill
4. R.C. Hibbeler: Engineering Mechanics - Statics & Dynamics: Pearson Education Asia
5. S. Timoshenko and D. H. Young: Engineering Mechanics: McGraw Hill
6. Nelson: Engineering Mechanics:TMH.

ME 1201 **THERMODYNAMICS-I** L T P C

Third Semester 3 1 0 8

(Mechanical Engineering Branch)

Pre-requisite-PH 1101, CH 1101, MA 1101, MA 1102

Concepts of Thermodynamics: Macroscopic and Microscopic concepts, System and its Classification. Thermodynamic State. Properties, Process and Cycles, Thermodynamic Equilibrium, Concept of Temperature, Temperature Scale, Energy Interactions (Work Transfer and its Different Modes, Heat Transfer).

First Law of Thermodynamics: First Law applied to Non Flow as well as Flow Processes, Concepts of internal Energy, Enthalpy, Specific Heats, PMMI, Energy Equations for Flow Systems, Application of Energy Equations to different Engineering Components.

Second Law of Thermodynamics: Need of the Second Law, Preliminary definitions, Different statements of the Second Law of Thermodynamics and their equivalence, Reversibility and Irreversibility, Causes of Irreversibility, Reversible Cycles, Carnot Theorem, Absolute Thermodynamic Temperature Scale, Third law of Thermodynamics.

Entropy: Clausius Theorem and Inequality, Entropy Principle, Entropy and Disorder, Evaluation of Entropy change during various processes, T-S and H-S diagrams, Concept of Third Law of Thermodynamics.

Properties of Substances: Gases-Equation of state of an Ideal Gas, Specific Heats, Internal Energy, Enthalpy and Entropy change of Ideal Gases.

Equation of state of Real Gases, Principle of corresponding state, Compressibility Factor.

Steam – Definition of Sensible Heat, Latent Heat, Saturation Temperature, Quality, Evaluation of Properties from Steam Table and Mollier Diagram.

Concept of Exergy Analysis: Concept of exergy, Irreversibility, exergy balance, exergy transfer accompanying heat, exergy transfer accompanying work, flow exergy, exergy balance for control volume. Exergetic efficiency, exergetic efficiencies of common components: turbines, pumps, nozzles etc.

Texts/Reference:

1. P.K. Nag: Engineering Thermodynamics, 5/e: Tata McGraw Hill
2. Cengel: Thermodynamics, 7/e: Tata McGraw Hill
3. Ganeshan: Engineering Thermodynamics: Tata McGraw Hill
4. M.J. Moran, Shappiro: A Text Book on Classical Thermodynamics: John Wiley & Sons Ltd.
5. Van Wylen: A Text Book on Classical Thermodynamics: John Wiley & Sons Ltd
6. Rogers and Mayhew: Engineering Thermodynamics: Pearson Education Publication

ME 1202 **THEORY OF MECHANISMS AND MACHINES** L T P C

Third Semester 3 1 0 8

(Mechanical Engineering Branch)

Pre-requisite- ME 1101, ME 1111, CE 1101, MA 1101, MA 1102

Introduction to Kinematics and Mechanisms: Elements of kinematic chain, Mechanism, Their inversions, Mobility and range of movements, The four bar Mechanism, Miscellaneous mechanisms, Straight line generating mechanisms, Intermittent motion mechanism.

Synthesis of Mechanism: Number synthesis – Grubler`s criterion inconsistencies, Grashoff`s law of mobility of a four bar mechanism, Transmission angle – determination of minimum value.

Belt Drive: Introduction, Velocity ratio, Belt Length, Limiting ratio of Belt Tensions, Maximum effective tension and Power transmitted, Centrifugal Tensions and stresses in Belt, Maximum tension and its role in Power Transmission, Initial tension and its role in power transmission, Condition for maximum Power Transmission, Idler Pulleys, materials of Belt drive

Gear Drive: Introduction, Rolling Contact and Positive drive ,Classification of Gears, Nomenclature for Straight Spur Gears, Fundamental law of tooted Gearing, Conjugate Teeth, Tooth Profiles, Contact Ratio, Interference and under cutting, Methods of reducing or eliminating Interference, Epicyclic Gear Trains

Governors: Types and application, Functions of a Governor, Characteristic of centrifugal governors ,Quality of

Governor: Definations of controlling forces, stability, sensitiveness, isochronisms, capacity and coefficient of insensitiveness, Spring controlled governors of Hartnel and Hartung types, Effect of friction, Effort and power, Effect of Friction: Insensitiveness.
Cam and followers: Principle, different types, cam profiles, follower motions.
Balancing: Static and dynamic force diagram, Inertia forces and their balancing for rotating and reciprocating machines, Identification of inertia forces for reciprocating masses in engine mechanisms, Partial primary balance of single cylinder engines and uncontrolled locomotives, Balancing of multi cylinder in line engines, V- twin engines, Radial engines – direct and reverse crank methods.

Texts/Reference:

1. S.S.Rattan: Theory of Machines: Tata McGraw Hill Publication
2. Bevan T: Theory of Machines: CBS publishing
3. H. H. Mabie & C. F. Reinholtz: Mechanisms and Dynamics of Machines: John Willey & Sons Publishing Co.
4. A. Ghosh & A.G. Ambekar: Theory Of Mechanisms and Machines: Jain Brothers, New Delhi
5. A. G. Ambekar: Mechanism and Machine Theory: PHI

ME 1203	**MANUFACTURING PROCESS – I**	L	T	P	C
	Third Semester	3	0	0	6

(Mechanical Engineering Branch)
Pre-requisite- PH 1101, CH 1101, ME 1101, ME1111

Metal Forming: Elastic and plastic deformation. Concept of strain hardening. Hot and cold working processes - rolling, forging, extrusion, swaging, wire and tube drawing. Machines and equipment for the processes. Parameters and force calculations. Test methods for formability.
Sheet Metal Working: Applications of sheet formed products. Shearing mechanism. Processes like blanking, piercing, punching, trimming, etc. Forming processes like bending, cup drawing, coining, embossing, etc. Presses for sheet metal working; Part feeding systems; Elements of die; punch and die clearances; Progressive, compound and combination dies. High energy rate forming processes.
Powder Metallurgy: Introduction. Production of metal powders. Compaction and sintering processes. Secondary and finishing operations. Economics, advantages, and applications of powder metallurgy.
Metal Casting: Introduction: Brief History, Advantages and Limitations, Applications
Patterns: Pattern materials, allowances, types of pattern, color code scheme
Sand Casting: Green and dry sand casting process, types of sand, molding sand and its properties, molding sand composition.
Cores: Use, core material, types of cores, advantages and limitations, core prints, chaplets
Gating and Risering System: Element of gating systems, types of gates, Riser design considerations
Special Molding Processes: Carbon dioxide molding process, Investment casting process, Die casting process, shell molding process, Full molding process, Vacuum-Sealed casting process
Casting defects: Causes and remedies of defects such as blowholes, pinholes, blisters, hot tears, cold shut, metal penetration,
Melting Practices: cupola: charge calculations, construction; other furnaces: working of induction furnace, crucible furnace, and reverberate furnace
Welding: Introduction: Principle of welding, general applications such as construction of bridges, towers, automobiles & electronic circuits, etc.
Classification of welding processes: Classification based on application of filler material & without filler material, source of energy, fusion and pressure welding processes. Various joining processes such as welding, brazing and soldering.
Soldering and brazing: Difference between both the processes, consumables used, methods of brazing, fluxes used, their purpose and flux residue treatment. Arc welding power sources; Conventional welding transformers, rectifiers & current and voltage. The influence of these power sources on welding.
Manual metal arc(MMA) or shielded metal arc (SMA) welding: Equipment requirement, electrodes for welding of structural steels, coating constituents and their functions, types of coatings; ISI electrode classification for plain carbon steel (IS 815:1974 & IS 814:1991), current and voltage selection for electrodes.
Submerged arc welding (SAW): Process details, consumables such as fluxes and wires for welding mild steel, variations in submerged arc welding process like single wire, tandem wire, parallel wires, field of applications.
Gas metal arc welding (GMAW) or MIG/MAG welding: Process details, shielding gases, electrode wires, their sizes, and welding current ranges.
TIG welding: Process details, power sources requirements, electrode sizes and materials, current carrying capacities of different electrodes, shielding gases, application of process.
Resistance welding: General principle of heat generation in resistance welding, application of resistance welding processes. Process details and working principle of spot, seam, and. projection welding, electrode materials, shapes of electrodes, electrode cooling, selection of welding currents, voltages, II manufacture of resistance seam welded (RSW) tubes by seam welding.

Texts/Reference:

1. Rao P N,3/e: Manufacturing Technology, (Volume I): Tata Mcgraw Hill Education Private Limited
2. S K Hajra Choudhury, S K Bose, A K Hajra Choudhury, Nirjhar Roy: Workshop Technology Vol I; Media Promoters & Publishers Pvt. Ltd.
3. Schey: Introduction to Manufacturing Process, 3/e: TMH
4. Nagendra B. S Parashar, Mittal R. K: Elements Of Manufacturing Processes: PHI Learning (2009)
5. Phillip F. Ostwald, Jairo Munoz: Manufacturing Processes and Systems, 9th Ed: Wiley India Pvt Ltd.
6. Begman & Amstead: Manufacturing Process: Addison- Willey Publishers.

ME 1204	**MATERIAL SCIENCE**	L	T	P	C
	Third Semester	3	0	0	6

(Mechanical Engineering Branch)
Pre-requisite- PH 1101, CH 1101

Structure of solids: Crystallographic planes and directions, methods of determining the crystal structures, atomic packing, crystal defects
Phase transformations and phase equilibrium: Stability of phases and equilibrium, phase transition, phase equilibrium diagrams, phase rule and equilibrium, cooling curves, solid solution equilibrium diagrams, iron-iron carbide equilibrium diagram
Rate processes and crystallization:
Kinetics of phase transformation, crystallization, nucleation, homogenous nucleation, heterogeneous nucleation, crystal growth, dendritic growth
Heat treatment of steels:
Annealing, normalizing and spheroidizing, quenching, hardenability, precipitation hardening, time temperature transformation diagram. ,continuous cooling transformation diagram, effect of alloying elements
Mechanical properties
Stress and strain, normal stress strain curve, true stress strain curve, toughness and resilience, fatigue, creep

Texts/References

1. Avner: Introduction to physical metallurgy: Mc Graw hill
2. Smith: Material Science & Engineering, 4/e: McGraw-hill
3. Dieter: Mechanical Metallurgy, 3/e: McGraw-Hill
4. Nazang: Material science: Khanna publisher

ME 1205	**MACHINE DRAWING**	L	T	P	C
	Third Semester	1	0	2	4

(Mechanical Engineering Branch)
Pre-requisite- CE 1101

ISI conventions in drawing, Surface finish, Fits and tolerance (to be indicated on working drawings), Orthographic projection of different types of composite bodies. Bolts and nuts, Keys, Pins, Set screws, Riveted joints, Welded joints, Pipe joints, Flanged coupling , Flat and V-belt pulleys, Threads(internal and external), Studs, Washers, Springs, Plain journal bearing, Ball and roller bearings.
Assembly and part drawings for parts such as: Stuffing box, Foot step bearing, Plummer block, Universal joints, Gear pump, Screw jack, Cross head of steam engine, Connecting rod, Piston assembly, Stuffing box, Eccentric sheave, Tail stock.

Texts/Reference:

1. N. D. Bhatt: Machine Drawing: Charotor Publishing House, Anand
2. Ajeet Singh: Machine Drawing, 2/e: Tata Mc Graw Hill Publishing
3. K.L.Narayana,P.Kannaiah & K.Venkata Reddy: Production Drawing: New Age International Publisher
4. R.K. Dhawan: A Text Book of Machine Drawing: S. Chand & Company Publishing House

ME 1206	**THERMODYNAMICS-II**	L	T	P	C
	Fourth Semester	3	1	0	8

(Mechanical Engineering Branch)

Pre-requisite-ME 1201, MA 1101, MA 1102, PH 1101, CH 1101

Thermodynamic property relations: Maxwell relation, specific heat relations, relations for changes in internal energy, enthalpy and entropy, Clapeyron equation, Joule-Thomson coefficient, generalized relations and charts for residual enthalpy and entropy

Gas Power Cycle: An overview of reciprocating IC engines, its classification, engine components, working principle of 2-stroke and 4-stroke engines, valve timing diagrams, engine performance parameters. An overview of gas turbine, its classification, air-standard cycle for gas turbine. Stirling and Ericsson cycles.

Vapour power cycle: Carnot cycle, Rankine cycle, actual vapour power cycle processes, reheat cycle, regenerative cycle, feed water heaters (open and closed), characteristics of an ideal working fluid in vapour power cycle, binary vapour cycles, thermodynamics of combined cycles.

Reciprocating air compressor: Single stage and multistage air compressors, work done per cycle, compressor capacity and power calculation, volumetric efficiency and isothermal efficiency, effect of clearance ratio on volumetric efficiency, intercooler and after cooler.

Combustion processes: Fuels and combustion, theoretical and actual combustion processes, enthalpy of formation and enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature, entropy change of reacting systems, second law analysis of reacting systems.

Refrigeration and Psychrometry: Gas cycle refrigeration, vapour compression refrigeration, vapour absorption refrigeration, types of refrigerants and properties of ideal refrigerants, psychrometric properties and processes, psychrometric chart.

Texts/Reference:

1. P.K. Nag: Engineering Thermodynamics, 5/e: Tata McGraw Hill
2. Cengel: Thermodynamics, 7/e: Tata McGraw Hill
3. Ganeshan: Engineering Thermodynamics: Tata McGraw Hill
4. Rogers and Mayhew: Engineering Thermodynamics: Pearson education
5. M J Moran: A Text Book on Classical Thermodynamics: John Wiley &sons.

ME 1207	**FLUID MECHANICS - I**	L	T	P	C
	Fourth Semester	3	1	0	8

(Mechanical Engineering Branch)

Pre-requisite- ME 1201, ME 1101, MA 1101, MA 1102, PH 1101

Introduction: Introductory concepts and definitions, properties and classification of fluids, Pascal's law of fluid pressure, measurement of pressure, forces on submerged plane and curved surfaces, buoyancy, metacenter.

Kinematics of Fluids: Introduction, scalar and vector fields, flow field and description of fluid motions, existence of flow.

Conservation Equations: System, conservation of mass, conservation of momentum and conservation of energy.

Applications of Equations of Motion and Mechanical Energy: Introduction, Bernoulli's equation in irrotational flow, measurement of flow rate through pipe, flow through orifices.

Principles of Physical Similarity and Dimensional Analysis: Introduction, concept and type of physical similarity, applications of dynamic similarity, dimensional analysis.

Laminar and Turbulent Flows: Introductions, definitions of laminar and turbulent flows, laminar flow through a circular pipe, laminar flow between parallel plates, laminar flow through an annulus, hydrodynamic lubrication.

Numerical solution of fluid mechanics problems: Numerical solution of simple problems of fluid mechanics, a brief introduction to Computational Fluid Dynamics

Texts/Reference:

1. S.K. Som and G. Biswas: Introduction to Fluid Mechanics and Fluid Machines: Tata McGraw Hill.
2. Sukumar Pati: Textbook of Fluid Mechanics & Hydraulic Machines, 1/e: McGarw-Hill
3. Cengel: Fluid Mechanics, 2/e: McGarw-Hill
4. Streeter: Fluid Mechanics , 9/e: McGarw-Hill
5. White: Fluid Mechanics, 7/e: McGarw-Hill
6. K.L. Kumar, Eurasia: Engineering Fluid Mechanics: Publishing House (P) Ltd
7. A.K. Jain: Fluid Mechanics: Khanna Publishers

ME 1208 **INSTRUMENTATION AND MEASUREMENT** L T P C

Fourth Semester 3 1 0 8

(Mechanical Engineering Branch)

Pre-requisite- ME 1101, MA 1101, MA 1102, ME 1201, ME1111

Generalized measurement system, Measurement terminology: Calibration,, Accuracy, Precision, Sensitivity, Threshold, Hysteresis, Dead space, errors in measurements, Dynamic characteristic of simplified measuring system, Characteristic of first order and second order systems.

Transducer elements: Analog transducers, Digital transducers, Intermediate elements – Amplifier, Compensator, Differentiating and Integrating elements, Filters, Data transmission elements.

Indicating and recording elements: Digital voltmeters, Cathode Ray Oscilloscope (CRO`S), Galvanometric recorders, Data acquisition systems.

Strain measurement: Types of electrical resistance strain gauges, Theory of operation, Gauge material, Gauge factor, Mounting techniques, Moisture proofing, Calibration circuits, Strain measurement in static and rotating shafts, Proper orientation of gauges, Commercial strain measuring system.

Measurement of Force, Torque and Pressure.

Force Measurement: Hydraulic and pneumatic load cells, elastic force devices.

Pressure Measurement–moderate pressure measurement, high pressure measurement, low pressure (Vacuum) measurement, elastic pressure measurement devices.

Torque Measurement: Transmission dynamometer, Absorption dynamometer**.**

Viscosity Measurements: Redwood viscometer.

Temperature Measurement: Temperature measurement using change in physical properties, electrical type temperature sensors, radiation thermometry.

Flow measurement: Head type area flow meter, solid flow meter, electrical type (Hot wire Anemometer) and accelerometers.

Miscellaneous Instruments in Industrial and Environmental application: Environmental air pollution measurement, gas chromatography.

Introduction to mechatronics and robotics.

Texts/Reference:

1. E. O. Doeblin and D. N. Manik: Measurement systems: Tata Mcgraw Hill Publishing Company Ltd.
2. B.C.Nakra , K.K.Chaudhary: Instrument Measurement and Analysis: Tata Mcgraw Hill Publishers
3. Holman: Experimental Methods for Engineers (Special Indian Edition),7/e: Mcgraw Hill Publishers
4. James W. Dailly, William F. Rilley, Kenneth G:. Instrumentation for Engineering Measurements: McConnell, Willey Student Edition
5. John H. Craig: Introduction to Robotics: Pearson
6. Thomas G. Beckwith, D. Marangonic, John H. Liehard V: Mechanical Measurement: Pearson Education
7. Richard S. Figliol, Donald E. Beasley: Theory and Design for Mechanical Measurements: Willey Student Edition

ME 1209 **MECHANICS OF SOLIDS** L T P C

Fourth Semester 3 1 0 8

(Mechanical Engineering Branch)

Pre-requisite- PH 1101, ME 1101, ME 1204, MA 1101, MA 1102

Properties of materials: definition

Simple stresses and Strains: Concept of stress and strain, constitutive relation, deformation of axially loaded bars, members with varying cross section, composite bars, thermal stress. Saint-Venant's Principle and stress concentration, lateral strain, Poisson's ratio, volumetric strain, elastic constants and their relationship. Strain energy due to axial loads- gradually and impact loads, , Thin walled pressure vessels.

Concept of stress and strain tensor, generalized Hooke's law

Transformation of stresses and strains: Stresses on inclined plane, Mohr's circle, principal plane, principal stresses, transformation of stress and strains in a plane, principal strains, Mohr's Circle of stress and strains.

Stresses in beams: SF and BM diagrams for cantilever, simple supported and overhanging beams, Relationship between rate of loading, SF and BM.

Theory of bending, assumptions, neutral axis and moment of resistance, bending stresses in symmetrical sections, section modulus, composite beams.

Shear stress distribution: rectangular, circular, I- section and and T- section

Torsional stresses in shafts: Analysis of torsional stresses, power transmitted

Combined Stresses: Combined bending and direct Stresses, resultant stresses for column of different sections subjected to eccentric load, limit of eccentricity for no tension, combined bending and torsion

Deflection of beams: Relationship among curvature, slope and deflections, slope and deflection for Cantilever and S. S beams, Machaulay's method.

Theories of failures: Significance, failure theories for ductile and brittle materials, Tresca Criterion, Von-Mises Yield criterion, Mohr's Theory. Failure due to creep and fatigue.

Texts/Reference:

1. Strength of Material by Rattan, McGraw-Hill Education
2. Mechanics of Materials by Beer & Johnson, Tata McGraw-Hill, New Delhi
3. Strength of Materials Part- 1 & 2 by Timoshenko
4. Engineering Mechanics of solids by E P Popov, PHI
5. Mechanics of Materials by Pytel & Singer, Harper Collins Publishers India Pvt. Ltd., New Delhi

		L	T	P	C
ME 1211	**ME Lab-I**				
	Fourth Semester	0	0	2	2
	(Mechanical Engineering Branch)				
	Pre-requisite-ME 1201, ME 1202, ME 1203, ME 1204				

All areas of Thermal Engg / Design / Manufacturing / Production Engg

		L	T	P	C
ME 1301	**DYNAMICS AND CONTROL OF MACHINERY**				
	Fifth Semester	3	1	0	8
	(Mechanical Engineering Branch)				
	Pre-requisite- ME 1101, ME 1202, ME 1209				

Static and dynamic force analysis: Introduction, Forces, moments and Couples, Static Equilibrium, Graphical Force Analysis, Analytical Approach to Force Analysis, Dynamic equilibrium of Systems of particles, Dynamic Equilibrium of System of rigid bodies, Flywheel, Gyroscope and gyroscopic effects, Cam Dynamics, Analysis of cam and follower.
Bearings: Hydrodynamic and boundary lubrication , Analysis of journal and thrust bearings.
Vibration: One degree of freedom system, Free and forced vibrations, Transverse and torsional vibration, Critical speed, Vibration isolation and measurements, Two degree of freedom systems, Vibration absorber, Multi degree of freedom system.
Control: Open and closed loop control, Block diagrams, Laplace transform, Mathematical model of physical system, Basic control action- pneumatic controller and hydraulic controller, Transient response of first order and second order system, Routh`s stability criteria, Frequency response analysis, Improving system performance, Introduction to non- linear control.

Texts/Reference:

1.Norton: Kinematics and Dynamics of Machinery (SIE): Mc Graw-Hill, 1/e,
2.Rattan: Theory of Machines: Mc Graw-Hill, 3/e
3.Gowda: Mechanical Vibrations: Mc Graw-Hill, 1/e
4.J. S. Rao & R.V. Dukkipati: Mechanism & Machine Theory: New Age International Publication
5.K. Ogata: Modern Control Engineering: Prentice Hall International
6.B. C. Kuo: Automatic Control System: Prentice Hall International
7.A.Ghosh & A.K. Mallick: Theory of Mechanisms & Machines: Affiliated East West Press Pvt Ltd
8.Kenneth J. Waldron and Gary L. Kinzel: Kinematics, Dynamics and Design of Machinery: Wiley India

		L	T	P	C
ME 1302	**FLUID MECHANICS-II**				
	Fifth Semester	3	1	0	8
	(Mechanical Engineering Branch)				
	Pre-requisite- ME 1207, ME 1201, ME 1206				

Flow of Ideal Fluids: Introduction, elementary flows in a two-dimensional plane, superposition of elementary flows, aerofoil theory
Viscous Incompressible Flows: Introduction, general viscosity law, Navier-Stokes equation, exact solution of Navier-Stokes equation.
Laminar Boundary Layer: Introduction, boundary layer equations, momentum-integral equation of boundary layer, separation of boundary layer.
Turbulent Flow: Introduction, classifications of turbulent flow, laminar-turbulent transition, mean motion and fluctuation, turbulent boundary layer.
Compressible Flow: Introduction, thermodynamic relations of perfect gases, speed of sound, pressure field due to a moving source. Basic equations for one-dimensional flow, stagnation and sonic properties, normal shock waves, Fanno line flows, Rayleigh line flow. Oblique shock.
Principles of Fluid Machines: Introduction, classification of fluid machines, hydraulic turbines and pumps.
Numerical solution of fluid mechanics problems: Numerical solution of fluid mechanics problems and its applications in Computational Fluid Dynamics.

Texts/Reference:

1. S.K. Som and G. Biswas: Introduction to Fluid Mechanics and Fluid Machines: Tata McGraw Hill.
2. Sukumar Pati: Textbook of Fluid Mechanics & Hydraulic Machines: McGarw-Hill, 1/e
3. Cengel: Fluid Mechanics: McGarw-Hill, 2/e
4. Streeter: Fluid Mechanics: McGarw-Hill, 9/e
5. White: Fluid Mechanics: McGarw-Hill, 7/e
6. Subramanian: Hydraulic Machines: McGraw-hill, 1/e
7. K.L. Kumar: Engineering Fluid Mechanics: Eurasia Publishing House (P) Ltd
8. A.K. Jain: Fluid Mechanics: Khanna Publishers

ME 1303	**MANUFACTURING PROCESS-II**	L	T	P	C
	Fifth Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1111, ME 1203, ME1202, ME1208

Introduction: Introduction to machine tools, motions of machine tools, generation of surfaces, types of machine tools, basic elements of machine tools.

Mechanics of Machining (Metal Cutting): Geometry of single point cutting tools, Conversion of tool angles from one system to another, Mechanism of chip formation, Orthogonal and oblique cutting, Use of chip breaker in machining, Machining forces and Merchant's Circle Diagram (MCD), Taylor's Tool Life Equations

Lathe: Principle, classification, specifications, operations performed on a lathe. Calculation for machining time, Machining parameters & performance.

Capstan and Turret Lathes: Introduction, comparison among capstan, turret and engine lathe, turret indexing mechanism, feeding mechanism, cutting tools and tool holders, turret tooling layout.

Shaper: Principle, classification, specifications, shaper mechanisms – crank and slotted lever quick return mechanism, feed mechanism, operations performed on shaper – machining horizontal, vertical, angular surfaces, cutting slots, grooves, key ways, machining irregular surfaces, splines and gears. Cutting speed, feed, depth of cut and calculation for machining time for shaping operations.

Planer: Principle, classification, specifications, comparison between shaper and planer.

Milling machine: Principle, classification, specifications, peripheral milling, up and down milling, face milling, end milling, different operations performed on milling machines, dividing heads, methods of indexing – direct, simple, compound and differential indexing, milling of spur gear, milling cutters.

Drilling machine: Principle, classification, specifications, operations performed on drilling machines, twist drill nomenclature.

Grinding machines: Principle, classification, specifications, different grinding processes, grinding wheel – components (wheel material), grit, grade and structure, standard marking system of grinding wheels. Glazing and loading in wheels, dressing, truing, balancing, and mounting of grinding wheels.

Texts/Reference:

1. P N Rao: Manufacturing Technology Vol 2- Metal Cutting and Machine Tools: Tata Mc Graw Hill
2. Schey: Introduction to Manufacturing Process: McGraw-Hill
3. S K Hajra Choudhury: Workshop Technology Vol II Machine Tools: Media Promoters & Publishers Pvt. Ltd.
4. G Boothroyd & W A Knight: Fundamentals of Machining and Machine Tools: CRC Press Taylor & Francis Group
5. H Gerling: All About Machine Tools: New Age Int. (P) Ltd.
6. R K Jain: Production Technology: Khanna Publishers
7. A. Ghosh & A. K. Mallik: Manufacturing Science: Affiliated East-West Press Pvt. Ltd.
8. B S Raghuwanshi: A Course in Workshop Technology Vol II (Machine Tools): Dhanpat Rai & Co.

ME 1304	**MACHINE DESIGN – I**	L	T	P	C
	Fifth Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1101, ME 1202, ME 1209

Introduction: General considerations and procedure of Machine Design, Mechanical properties, Design stress, factor of safety, Stress-strain diagram for ductile and brittle materials, Theories of failure, Stress concentration factor, Design for variable loads: endurance limit, Goodman and Soderberg criteria.

Riveted Joints: Types, Modes of failure, Strength and efficiency of riveted joints, Pitch of rivets, Design stresses, Structural joints of butt and lap type, Boiler joints, Rivets subjected to eccentric loading.

Welded Joints: Types of welds, Strength of welds, Eccentric load in plane of weld, Welded pressure vessel and some practical applications.

Keys and Pins: Types of keys, Stresses in keys, Design of square, rectangular and taper keys.

Shafts: Shafts subjected to twisting moment, bending moment, combined twisting and bending moment, fluctuating loads, axial load in addition to combined torsion and bending loads
Coupling: Rigid and flange coupling, Design of flange coupling
Cotter and Knuckle Joints: Design of Socket and spigot cotter joints, Sleeve and cotter joints, Gib and cotter joint for strap end of a connecting rod, Gib and cotter joint for square rods, knuckle joint.
Lever: Application of lever in engineering practice, Design of a lever, Foot lever, Cranked lever, Lever for lever safety valve, Bell crank lever.

Texts/Reference:

1. Bhandari: Design of Machine Elements: McGraw-Hill Publishers, 2/e
2. Shigley: Mechanical Engineering Design: McGraw Hill Publishers, 9/e
3. Bhandari: Introduction to Machine Design:. B, McGraw Hill Publishers, 3/eV
4. R. S. Khurmi & J. K. Gupta: Machine Design: S. Chand & Co
5. Sharma & Agarwal: Machine Design: S. K. Kataria & Sons
6. Kannaiah, P: Machine Design: SCITECH Publications
7. Mahadevan K, Reddy: Design Data Handbook: KB, CBS, New Delhi
8. Spotts: Design of Machine Members: Prentice Hall Publishers

		L	T	P	C
ME 1311	**ME Lab-II**	0	0	3	3

Fifth Semester
(Mechanical Engineering Branch)
Pre-requisite- ME 1211, All theory subjects in previous semesters

All areas of Thermal Engg / Design / Manufacturing / Production Engg

		L	T	P	C
ME 1312	**ME Lab-III**	0	0	3	3

Fifth Semester
(Mechanical Engineering Branch)
Pre-requisite- ME1211, All theory subjects in previous semesters

All areas of Thermal Engg / Design / Manufacturing / Production Engg

		L	T	P	C
ME 1305	**AUTOMOBILE ENGINEERING**	3	1	0	8

Sixth Semester
(Mechanical Engineering Branch)

Pre-requisite-ME 1201, ME 1202, ME 1206, ME 1301, ME1304

Introduction: Automotive Vehicles, Development, Layout and types of automotive vehicles- cars, buses, tractors, air cushion vehicles and off the road vehicles, Various resistance to the motion of a vehicle, Power required for propulsion, Acceleration and hill climbing.
Automotive engine: classification, S.I. and C.I. engines, combustion chamber types, engine balancing, multi-cylinder arrangements.
Automobile engine parts: Cylinder block, cylinder head, crank case, oil pan, cylinder liners, piston, piston rings, connecting rods, crank shaft, valves, valve actuating mechanism, valves layout, materials used, valve and port timing diagrams.
Fuel supply system: Simple carburettor, constant choke, constant vacuum carburettor, types of carburettor, mixture strength requirements, fuel pumps for petrol engines, petrol injections, diesel fuel pump and fuel injector for diesel engines.
Ignition system: Battery ignition system, comparison between battery ignition and magnetic ignition system, ignition advance methods, electronic ignition.
Cooling system: Necessity, coolant types, methods of cooling.
Lubrication system: Objectives, system of engine lubrication, crank case ventilation.
Chassis construction: The frame and its functions, layout of the components of transmission system in four wheel rear drive vehicles.
Clutches: Purpose, requirements, relative merits and demerits of different types of clutches.
Transmission System: Purpose, sliding mesh gear box, constant mesh gear box, power flow diagrams, torque converter, automatic transmission - an overview.
Universal coupling, propeller shaft, final drive - types, functions. Differential - purpose, construction.
Suspension System: Semi-floating, full floating and three quarter floating construction,

Steering System: Steering mechanisms, steering linkages, steering gears - for rigid front axle and independent front wheel suspension.
Brakes: types of brakes, numerical problems relating to brake torque, minimum stopping distance with front wheel braking, rear wheel braking, wheel braking and heat dissipation.

Electrical equipment: Generator, voltage regulator and cut-out, starter, lighting circuit.
Application of CNG in automotive engines.
CFD analysis of flow over surfaces of Automobiles

Texts/Reference:

1. Automotive Mechanics, 2/e, by Srnivasan, McGrawhill
2. Automotive Mechanics (Special Indian Edition), 10/e, by Crouse, McGrawhill
3. Automobile Engineering Vols - I & II, by Kirpal Singh, Standard Publishers Distributers
4. Automotive Mechanics by Heitner Joseph, East West Press
5. Automobile Engineering by William H. Crouse & Donald L Anglin

ME 1306	**TURBO MACHINERY**	L	T	P	C
	Sixth Semester	3	1	0	8

(Mechanical Engineering Branch)

Pre-requisite- ME 1201, ME 1206, ME 1207, ME1302

Introduction: Definition of a turbo-machine, Fundamental theory of turbo-machines, and classification of turbo machinery
Hydraulic Turbines: Introduction, Classifications of hydraulic turbines, Concepts of heads of turbines, Concept and definitions of efficiencies of turbines. Impulse Turbines : Main components of Pelton turbines, Design of components of Pelton turbines, Force, Power and efficiency of Pelton turbine. Reaction Turbines Main components of modern Francis turbine, Design of components of Francis turbine, Torque, Power and efficiency of Francis turbine, Component and design of Propeller and Kaplan turbines. Draft tube, Function and efficiency of draft tube, Types of draft tube, Governing of turbines, Governing of hydraulic turbines, Specific speed, Performance characteristic curves of turbines, Selection and performance of turbines, Cavitations of turbines.
Centrifugal Pumps: Introduction, Main components of Centrifugal pumps, Definitions of head and efficiency of a centrifugal pump, Working principle, Priming of centrifugal pump, Multistage centrifugal pumps Specific speed, Performance characteristic curves of pumps, Selection and performance of a centrifugal pump, Cavitation in pump, operational difficulties in centrifugal pumps. Axial Flow Pumps.
Steam Turbines: Introduction, Working principle of steam turbine, Classification of steam turbine, simple impulse turbine, compounding of steam turbine, pressure compounded impulse turbine, velocity compounded impulse turbine, pressure-velocity compounded impulse turbine. Flow through impulse turbine blades, Velocity triangle, work done, power and efficiencies, Blade sections.
Flow through impulse reaction turbine blades, Velocity triangles, work done, efficiencies, Degree of reaction, Parson's Turbine, Blade sections, Governing of steam turbines.
Losses of steam turbines, State point locus, reheat factor, turbine efficiency parameters.
Centrifugal Compressor: Introduction, Basic Components, Principle of Working, Velocity Triangle, Enthalpy-Entropy Diagram, Slip, Power Input Factor, Compressor Efficiency, Flow Coefficient, Pressure Coefficient, Degree of Reaction, Pre-whirl, Effect of Impeller Blade Shape on Performance, Vaned and Vaneless Diffuser, Surging and Choking in Compressor.
Axial Flow Compressor: Introduction, Basic Components and Principle of working, Stage Velocity Triangle, Enthalpy-Entropy diagram, Work done factor, Degree of reaction, Polytropic efficiency, Flow Coefficient, Pressure Coefficient, Compressor Stalling.
Fan and Blower: Centrifugal fan, Fan Impeller, performance and point of operation, axial flow fan, blade profiles, performance and blowers.

Texts/Reference:

1. Ganesan: Gas Turbine: McGraw-Hill Education, 3/e
2. S.M. Yahya, Satyaprakashana: Turbines, Compressors and Fans: Publishers, New Delhi, 4/e
3. R. Yadav: Steam & Gas Turbine and Power Plant Engineering: Central Pub. House
4. R. K. Bansal: A Test Book of Fluid Mechanics and Hydraulic Machines: Laxmi Pub.
5. Earl Logan: Turbomachinery: Jr. Marcel Dekker Inc.
6. S. L. Dixon: Fluid Mechanics and Thermodynamics of Turbomachinery: Butterworth- Heinmann

ME 1307	**ADVANCED MANUFACTURING PROCESS**	L	T	P	C
	Sixth Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1203, ME 1303

Introduction to Advanced Manufacturing Processes and their importance.
Advanced Machining Processes: Introduction of advanced machining processes, process principle, applications, advantages and limitations of processes such as Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM), Ultrasonic Machining (USM), Electrochemical Machining (ECM), Electro Discharge Machining (EDM), Electron Beam Machining (EBM), Laser Beam Machining (LBM) processes.
Advanced Casting Processes: Metal mould casting, continuous casting, squeeze casting, vacuum mould casting, evaporative pattern casting, ceramic shell casting their process principles and applications.
Advanced Welding Processes: Electron Beam Welding (EBW), Laser Beam Welding (LBW), Ultrasonic Welding (USW), their process principles and applications.
Advanced Metal Forming Processes: High energy rate forming (HERF) process, Electromagnetic forming, explosive forming, Electro hydraulic forming, Stretch forming, Contour roll forming, their process principles and applications.
Rapid prototyping (RP): Importance of RP, introduction of solid-based, liquid-based, powder-based RP processes.
Introduction to emerging trends in manufacturing: Micro-manufacturing, Micro-Electro-Mechanical-Systems (MEMS), basic concepts of Nanotechnology.

Texts/Reference:

1. Schey: Introduction to Manufacturing Processes: McGraw-Hill Publisher, 3/e
2. Courtney: Mechanical Behavior of Materials: McGarw-Hill Publisher, 2/e
3. E. P. DeGarmo, J. T Black, R. A. Kohser: Materials and Processes in Manufacturing (8th Edition): Prentice Hall of India, New Delhi (ISBN 0-02-978760).
4. A. Ghosh, and A. K. Mallik: Manufacturing Science: Affiliated East-West Press Pvt. Ltd. New Delhi.
5. G.F. Benedict, Marcel Dekker: Nontraditional Manufacturing Processes, Inc. New York (ISBN 0-8247-7352-7).
6. N. P. Mahalik: Micromanufacturing and Nanotechology: Springer

ME 1308	**MACHINE DESIGN - II**	L	T	P	C
	Sixth Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1202, ME 1209, ME 1304

Threaded Fasteners and Power Screws: Stresses in bolts, Effect of initial tension, Bolts under dynamic and impact loading, Eccentric loading, Power screws, Form of threads, Force analysis, Screw and nut design, Differential and compound screws. Stresses in power screws.
Belt Drive: Introduction, Mechanics of belt drive, Belt Materials, Selection of a pulley, Design of Flat belts, Design of V-belts.
Springs: Application and classification of springs, Stress in coil springs of round, square and rectangular wires, Deflection of coil springs, Design of compression and tension springs, Coil spring subjected to impact and fluctuating loads, Material for coil springs, Critical frequency, Energy stored in springs.
Clutches: Positive and Frictional clutches, Plate friction or disc clutches, Cone clutches.
Brake: Block brakes, Band brakes, Disc brakes (internal expanding and external contacting shoe
Gears: Spur gears – Nomenclature, interference in involute gears, beam strength of spur tooth, Lewis equation and Lewis form factor, velocity factor, Barth`s formula, working stresses in gear teeth, dynamic loads on gear teeth, design of spur gear for wear (Buckingham equation).
Helical gears – Nomenclature, Virtual number of teeth, Tooth Properties, Force Analysis. Beam strength, Dynamic loading, Wear strength.
Bearing: Type of bearings, Selection of bearing, Theory of lubrication, Heat balance of bearing, Mechanical aspects of bearing design. Load and life of bearings, Equivalent bearing load, Load- life relations.

Texts/Reference:

1. Bhandari: Design of Machine Elements: McGraw-Hill Publishers, 2/e
2. Shigley: Mechanical Engineering Design: McGraw Hill Publishers, 9/e
3. Bhandari,V. B: Introduction to Machine Design: McGraw Hill Publishers, 3/e,
4. R. S. Khurmi & J. K.Gupta: Machine Design: S. Chand & Co
5. Sharma & Agarwal: Machine Design: S.K. Kataria & Sons
6. Kannaiah: P Machine Design: SCITECH Publications
7. Mahadevan K, Reddy KB: Design Data Handbook: CBS, New Delhi
8. Spotts: Design of Machine Members: Prentice Hall Publishers

ME 1309	**HEAT TRANSFER**	L	T	P	C
	Sixth Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1201, ME 1206, ME 1207, ME 1302

Conduction Heat Transfer: One- dimensional heat conduction equation for slab, cylinder, sphere and composite medium (with and without heat generation), Concept of critical thickness of insulation. Numerical methods for solution of heat conduction problems.
Heat Transfer For Extended Surfaces: Analysis of steady- state heat transfer for fins of uniform cross-section, Fin performance.
Radiation Heat Transfer: Nature of thermal radiation, Radiative properties, Kirchoff`s law, Black body radiation intensity and total emissive power, Displacement law, Radiation heat transfer between black/grey surfaces, network method of solving radiation problems, Concept of view factor.
Convection: Application of dimensional analysis to free and forced convection, Concept of velocity and thermal boundary layer, Equations of motion and energy, Empirical equations of convective heat transfer, Reynold`s analogy, Heat transfer in boiling and condensation.
Heat Exchangers: Basic types of heat exchanger, LMTD and $\in$- NTU method of heat exchanger analysis.
Computational studies in heat transfer processes in Conduction, Convection and Radiation. Experimental techniques related to heat transfer analysis. Heat transfer analysis from commercial software.

Texts/Reference:

1. Holman: Heat Transfer:, McGraw-Hill Publications, 10/e
2. Cengel: Heat & Mass Transfer: McGraw-Hill Publishers, 4/e
3. Kays: Convective Heat & Mass Transfer: McGarw-Hill Publishers
4. P.K.Nag: Heat Mass Transfer: McGarw-Hill Publishers, 3/e
5. Kreith: Principles of Heat Transfer: International Publication
6. Christopher A. Long: Essential Heat Transfer: Pearson Education Publication
7. Manuals of Fluent Software related to Heat Transfer Analysis
8. M. Necati Ozisic: Heat Transfer, A Basic Application: Mc.Graw Hill Publication

ME 1313	**WORKSHOP PRACTICE**	L	T	P	C
	Sixth Semester	0	0	3	3

(Mechanical Engineering Branch)

Pre-requisite- ME 1111

All areas of Thermal Engg / Design / Manufacturing / Production Engg

ME 1314	**ME LAB-IV**	L	T	P	C
	Sixth Semester	0	0	3	3

(Mechanical Engineering Branch)

Pre-requisite- ME 1311, ME 1312, All theory subjects in previous semesters

All areas of Thermal Engg / Design / Manufacturing / Production Engg

N.B.: ***Industrial Training after Sixth Semester for a period of 4-6 weeks as an audit course***

ME 1401 **INDUSTRIAL ENGINEERING AND OPERATION RESEARCH** L T P C

Seventh Semester 3 0 0 6

(Mechanical Engineering Branch)

Pre-requisite- HS 1301, MA1101, MA1102,MA 1201

Work Study & Motion Study: Historical background; Work study definition; Role of work study in improving productivity; Ergonomics and work study. Work study procedure: selection of jobs; Information collection and recording; Recording techniques -charts and diagrams; critical analysis; developing better method; installation and follow up of standard method. Memomotion and micromotion study; therbligs; cyclegraph and chronocycle graph; simochart; Principles of motion economy; Design of work place layout.
Work measurement: Definition; Procedure; Performance rating; Concept of normal time; allowances. Work sampling technique of work measurement. Introduction to pre -determined motion time system.
Quality & Reliability: Introduction and definitions of quality, Evolution of Quality: Inspection, Quality Control, Customer-Orientation: Internal & External Customer Concept, Life cycle approach to quality costs- Prevention; Appraisal and Failure costs. Seven QC tools (Histogram, Check sheets, Ishikawa diagrams, Pareto, Scatter diagrams, Control charts). Process capability concepts. Reliability: Introduction, Definitions, reliability evaluation, maintainability, and availability concepts.
Facilities Design: Site Selection: Factors influencing the selection, rural and urban locations of sites, optimum decision on choice of site and analysis. Plant Layout: Types of production, types of layouts, advantages and disadvantages of layout, factor affecting layout, systematic layout planning, Material handling: importance, principles of material handling
Operations Research: Introduction, general methodology of OR, application of OR, Formulation of linear programming, deterministic models, graphical solution, simplex algorithm
Capacity Planning: Introduction, measures of capacity, capacity strategies, A systematic approach for capacity decisions, Long range capacity planning and control, Medium range capacity planning and control, Short range capacity planning and control.
Inventory Management: Introduction, Inventory related costs, EOQ model, EPO model, Inventory models allowing shortages, Inventory models allowing price discounts, Inventory model under risk conditions, Inventory control systems: continuous review, periodic review, optional replenishment etc., Inventory classification systems: ABC, FMS, VED etc, MRP.
CPM / PERT: Introduction, Project scheduling with CPM, Project scheduling with PERT. Loading and Scheduling , General scheduling problem, Significance of loading and scheduling, Factors affecting scheduling, Scheduling system, Flow shop scheduling, Job shop scheduling, Sequencing, Line balancing.
Forecasting: Introduction, Demand patterns, Factors affecting demand, Subjective forecasting methods, Casual forecasting methods, Time series forecasting methods, Routine short term forecasting methods, Selection of forecasting model.
PPC: Introduction, System approach, Types of manufacturing systems, Factors affecting manufacturing systems. Product design and development, Introduction, marketing aspects, functional aspects, operational aspects, durability and dependability, aesthetic aspects, economic analysis, profit and competitiveness, the three S's, break even analysis, economics of a new design, production aspects.

Texts/Reference:

1. S.N. Chary: Production And Operations Management: McGraw Hill Publ, 5th Edition
2. Chase: Operations and Supply Management (SIE): McGraw Hill Publ, 12/e
3. Saxena: Production and Operations Management: McGraw Hill Publ, 2/e
4. O.P. Khanna: Industrial engineering and management: Dhanpat Rai & Sons

ME 1402 **POWER PLANT ENGINEERING** L T P C

Seventh Semester 3 0 0 6

(Mechanical Engineering Branch)

Pre-requisite- ME 1206, ME 1302, ME 1306, ME 1309

Power Plant In General: Introduction to different power plants, Load and Load duration curves, Location factors for power Plants, Power plant economics, Indian energy scenario.
Steam Power Plant: Introduction, Rankine cycle, Carnot cycle, Reheating of steam, Regeneration, Steam power plant appraisal, Deaeration, Typical layout of steam power plant, Efficiencies in steam power plant, Different types of fuel used for steam Generation, Draught system, Classification of boilers, Boiler accessories, Classification of steam turbines and their working, Co-generation plant for power and process heat, Combined cycle plant for power generation.

Gas Turbine Power Plant: Introduction, Classification of different gas turbine power plants, Analysis of closed cycle and open cycle constant pressure gas turbine plant, components of gas turbine plants.
Diesel Electric Power Plants: Introduction, Application of diesel engines in power field, Advantages and disadvantages of diesel engine power plant, General layout, Performance characteristics, Supercharging and Turbocharging.
Hydro-Electric Power Plant: Introduction, Classification of hydro-electric power plant, Site selection, Hydrographs, Flow duration curves, Elements of hydro-electric power plant, Advantages of hydro-electric power plant, Classification of hydraulic turbines and their selection.
Nuclear Power Plant: Introduction to nuclear engineering, Types of nuclear reactors, Pressurized water reactor, Boiling water reactor, CANDU reactor, Gas-cooled reactor, Liquid metal fast breeder reactor, India`s nuclear power programme.
Non-Conventional Power plants: Prospect of renewable energy source, Types of non-conventional power plants, Solar thermal and solar photovoltaic plants, Wind power plants, Bio-mass plants, Geo-thermal power plant, Tidal power plant.

Texts/Reference:

1. R.K. Rajput: Power Plant Engineering: Laxmi Publication
2. P.K. Nag: Power Plant Engineering: Tata McGraw Hill Publisher
3. R.K. Yadav: Steam & Gas Turbines & Power Plant Engineering: Central Publishing House, 7th ed
4. Arora & Dom Kundwar: A Course In Power Plant Engineering: Dhanpat Rai & Sons
5. P.C. Sharma: Power Plant Engineering: S.K. Kataria & Sons

		L	T	P	C
ME-1411	**ME LAB - V**				
	Seventh Semester	0	0	2	2

(Mechanical Engineering Branch)

Pre-requisite- ME 1311, ME 1312, ME 1314, All theory subjects in previous semesters

All areas of Thermal Engg / Design & Manufacturing / Production Engg

		L	T	P	C
ME 1421	**REFRIGERATION**				
	(Departmental Elective – I) Seventh Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1201, ME 1206, ME 1309

Introduction: History, Methods of refrigeration, Ice production, Units of refrigeration, Review of thermodynamics, Difference between heat engine, refrigerator and heat pump.
Air Refrigeration System: Carnot and Brayton cycles, Aircraft refrigeration systems - Simple, Boot-strap, Regenerative and reduced ambient system, Advantages and disadvantages.
Vapour Compression System: Analysis of simple cycles, Representation on T-s and p-h plot and its use, Methods of improving COP, Actual cycle, Introduction to compound compression and multiple evaporator system, Expression for COP and power required.
Vapour Absorption System: Theoretical analysis of VAR. system, Advantages and disadvantages, Practical VAR system, Aqua- ammonia and Lithium- Bromide- Water VAR systems.
Refrigerants: Nomenclature, Classification, Desirable properties, Environmental regulations.
Application of Refrigeration: Domestic, commercial, industrial and medical refrigeration, Cold- storage, etc.

Texts/Reference:

1. C. P. Arora: Refrigeration and Air conditioning: TMH, 3/e
2. M. Prasad: Refrigeration and Air conditioning
3. Stocker & Jones: Refrigeration and Air conditioning: TMH
4. Jordan & Preister: Refrigeration and Air conditioning
5. P. N. Ananthanarayan: Refrigeration and Air conditioning: TMH
6. S. K. Kulshrestha: Refrigeration and Air conditioning
7. ASHRAE: ASHRAE Hand Book Of Fundamentals
8. M. Prasad: Refrigeration and Air conditioning Data Book

ME 1422	**PRINCIPLES OF COMBUSTION**	L	T	P	C
	(Departmental Elective – I) Seventh Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1206, ME 1305, ME 1309, CH 1101

Introduction: Review of chemical thermodynamics and chemical kinetics: heat of formation, heat of reaction, calculation of adiabatic flame temperature, equilibrium calculations, Conversation equations for multicomponent systems.

Pre-mixed systems: Flammability limits; Detonation and deflagration; Detonation wave structure; Transition from deflagration-to-detonation; Methods of solving laminar flame problems; Effects of different variables on flame speed; Methods of measuring flame velocity; Flame quenching. Non-Pre-mixed systems; Burke-Schumann's theory of laminar diffusion flames; Droplet burning; Laminar diffusion flames. Burning of solids, spray combustion. Practical aspects of combustion; Combustion and the environment.; fire and combustion; Practical devices; burners, explosives, propulsion methods, combustion chambers.

Texts/Reference:

1. Turns: An Introduction to Combustion: Concepts and Applications: McGraw-Hill Education, 3/e

ME 1423	**ADVANCED SOLID MECHANICS**	L	T	P	C
	(Departmental Elective – I) Seventh Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1209

Thick cylinders: Derivation and solution of differential equations of equilibrium, stresses produced by shrink fit, compound cylinders
Rotating rims and discs: Stresses on thin rotating rims and rotating discs of uniform thickness, derivation, solution of differential equations , rotating discs of variable thickness, stresses in flywheel.
Columns and struts: Definition, basic structures, Euler's Equation and Rankin's formula.
Curved beams: Difference between straight and curved beam theories, pure bending of curved beams, Winkler Back theory, bending of curved beams by forces acting in the plane of symmetry, particular cases of curved beam sections.
Unsymmetrical bending: Product second moment of area, principal second moment of area, Mohr's circle of second moment of areas, determination of resultant stresses at a point, orientation of neutral axis, cases of symmetrical and unsymmetrical sections, shear center.
Introduction to Fracture mechanics, Contact stresses and Finite element methods. Application of energy method.
Texts/Reference:

1. L.S. Srinath: Advance d Mechanics of solids: TMH, 3/e
2. S. S. Rattan: Strength of Material: McGraw-Hill
3. Beer & Johnston: Mechanics of Materials: Tata McGraw-Hill, 5/e
4. Roy R. Craig, Jr: Mechanics of Materials: John Whiley
5. Krishnaswamy, Kulkarni & Gharpure: Advanced Strength of Materials: Khanna Publishers,
6. E. P. Popov: Mechanics of Materials: Pearson
7. Krishna Raju & Gururaja: Advance Mechanics of Solids & Structures: Narosha Publishing House

ME 1424	**FUNDAMENTALS OF INDUSTRIAL DESIGN**	L	T	P	C
	(Departmental Elective – I) Seventh Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1304, ME 1308, ME 1204, HS 1201

Introduction: The design process, Steps in design process, Morphology of design, Mechanical engineering design, Traditional design methods, Design synthesis, Aesthetic and ergonomic considerations in design, Use of standards in design, Selection of preferred sizes, design for Maintenance (DFM).

Sources of Information and Communicating the Design: The information problem, Copyright and copying, Sources of information, Patents, Elements of communication system, Recording of results, Writing the technical report, Conducting a meeting, Oral presentation, Visual aids and graphics.
Materials Selection: Performance characteristics of materials, Materials selection process, Economics of materials, Evaluation methods of materials selection – cost versus performance relation, weighted index, value analysis etc.
Manufacturing Considerations in Design: Role of processing in design, Types of manufacturing processes, Economics of manufacturing, Design for castings, Forgings, Sheet metal forming, Design for machining, Powder metallurgy, Welding, Heat treatment, Assembly, Corrosion resistance, Designing with plastics, Concurrent engineering approach.
Value Engineering: Introduction, Categories of costs, Methods of developing cost estimates, Cost indexes, Cost-capacity factors, Factor methods of cost estimation, Manufacturing costs, Overhead costs, Standard costs, How to price a product, Life cycle costing.
Economic Design Making: Mathematics of time value of money, Cost comparison, Depreciation, Taxes, Profitability of investments, Inflation, Sensitivity and break-even analysis, Uncertainty in economic analysis, Benefit cost analysis.

Texts/Reference:

1. George Ellwood Dieter: Engineering Design: A Materials and Processing Approach: McGraw-Hill; 4th edition
2. V. B. Bhandari: Design of Machine Elements: TMH, 3/e

ME 1425	**PRODUCTION MANAGEMENT**	L	T	P	C
	(Departmental Elective – I) Seventh Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- HS 1301, HS 1201

Introduction: Introduction to Production Systems and a Generalized Model of Production, Life cycle of a Production System and Major managerial Decisions, Role of Models in Production Management
Financial Evaluation of Capital Decisions: Performance Measures of a Production System, Financial Evaluation of Capital Decisions, Decision Trees and evaluation of risk
Designing Products & Services: Introducing New Products and Services, Economic Evaluation of New Products & Services, Product Mix Decisions, Product & Process Design
Facility Location and Layout: Plant Location, Process Layouts, Product Layouts and Assembly Line Balancing, Cellular Layouts, Layouts for Advanced Manufacturing Systems
*Production Planning over Medium Term Horizon**:*** Demand Forecasting, Aggregate Production Planning
Operational Decisions over the Short Term: Inventory related Decisions, Material Requirements Planning, Scheduling of Job Shops
Project Management: An Overview, Project Identification and Screening, Project Appraisal, Project Selection, Development of Project Network, Project Representation, Consistency and Redundancy in Project Networks, Basic Scheduling with A-O-A Networks, Basic Scheduling with A-O-N Networks, Project Scheduling with Probabilistic Activity Times, Linear Time-Cost Tradeoffs in Projects: A Heuristic Approach, Resource Profiles and levelling, Limited Resource Allocation, Project Monitoring and Control with PERT / Cost, Team Building and Leadership in Projects, Organizational and Behavioral Issues, Project Completion, Review and Future Directions.

Texts/Reference:

1. Panneerselvam R Publisher: Production & Operations Management: PRENTICE H, Second Edition
2. Chary, S N: Theory And Problems In Production And Operations Management: Tata McGraw-Hill
3. V K Dubey: Production Management-A New Concept: Commonwealth Publishers
4. Kanishka Bedi: Production And Operations Management:: Oxford University Press
5. Muhlemann, Oakland & Lockyer: Production & Operation Management: Macmillan
6. Riggs, J. L: Production Systems: Planning & Control: John Wiley & Sons
7. Mukherjee & Kachwala: Operations Management and Productivity Techniques: PHI
8. Richman: Project Management Step by Step: PHI
9. Chase: Operations and Supply Management (SIE) (with DVD), McGraw-Hill, 12/e
10. Saxena: Production and Operations Management: McGraw-Hill, 2/e

ME 1426	**NUMERICAL CONTROL OF MACHINE TOOLS**	L	T	P	C
	(Departmental Elective – I) Seventh Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1303, ME 1301, EE 1101, EC 1101, ME 1208

Introduction: Fundamentals of Numerical Control (NC), Computer Numerical control (CNC), Direct Numerical control (DNC), comparison between conventional and CNC systems, Classification of CNC system, Design consideration in CNC machine tools, Industrial applications of CNC, Economic benefit of CNC.
System Devices: Drives, Feed back devices, Counting devices, Data Input Devices, Lead screws.
Control Systems: Fundamental problems of control, Position or point to point, straight line and contouring control, Machine tool control, Open and closed loop control, Adaptive Control system.
Interpolation: Digital differential analyzers (DDA) integrator, DDA hardware interpolator, CNC software interpolators, Software DDA interpolator, Linear and Circular interpolation.
NC Part Programming Concepts: NC coordinate system, Part programming terminology, preparatory and miscellaneous Codes, Part programming formats, procedures and methods, Manual programming, Computer aided programming, APT programming and practice.
Associated Systems of CNC: Introduction to Flexible manufacturing systems (FMS), CAD/CAM, Industrial robots, CIM systems.

Texts/ Reference:

1. Mehta: Machine Tools Design and Numerical Control: McGraw-Hill, 3/e,
2. Yoram Koren: Computer control of manufacturing system: Mc Graw Hill Book Co.
3. B. L. Jones: Computer Numerical Control: John Wiley and Sons.
4. Chen and Lin: Computer Numerical Control: Glory Educational Resource Inc.
5. Rao, Tiwari and Kunda: Computer Aided Manufacturing: Tata Mc Graw Hill
6. Groover and Zimmer: CAD/CAM: PHI
7. Groover: Automation, Production systems and computer integrated manufacturing: PHI
8. Chang, Wysk and Wang: Computer aided manufacturing: PHI

ME 1427	**ENGINEERING INSPECTION AND QUALITY CONTROL**	L	T	P	C
	(Departmental Elective – I) Seventh Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1208, ME 1304, ME 1308

Interchangeable system of manufacture, types of interchangeability, limit gauge, Taylor's gauging principle, design of inspection gauges
Surface textures, numerical assessment of surface texture, use of stylus type instruments, measurement of gear elements, gear errors, measurement of thread elements, thread errors.
Mechanical, optical, optical mechanical comparators, pneumatic comparator, Optical principles of measurement, toolmaker's microscope . interferometry.
Causes of variation in quality characteristics, principles of quality control by the use of control charts.

Texts/Reference:

1. Bewoor: Metrology & Measurement: McGraw-Hill Publishers
2. Gupta: Total Quality Management: McGraw-Hill Publisher, 2/e
3. Mahajan: A text book of metrology: Dhanpat Rai and Co.
4. Halpern: The assurance sciences: Prentice hall of India private limited

ME 1431	**I.C. ENGINES**	L	T	P	C
	(Departmental Elective – II) Seventh Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1206, ME 1305

Introduction: Basic design components and nomenclature, Review of Classifications of I.C. engines, working principles of engines, comparison of S.I. and C.I. engine, comparison of two stroke and four stroke cycle engines, engine performance parameters.

*Air Standard Cycles and their Analysis:*Review of Carnot cycle, Otto cycle, Diesel cycle, Limited pressure cycle, Brayton cycle, Stirling cycle, and other cycles.
Fuel Air Cycles and their Analysis: Significance, Effect of operating variables, Actual cycles, Various losses in actual cycles, Fuels- important qualities of engine fuels.
Carburetion: Factors affecting carburetion, Air-fuel mixtures, The simple carburettor, Essential parts of modern carburettors, Working of various carburettors.
Injection: Air injection system, Solid injection system, Common rail system, Injection pump, Nozzle, Quantity of fuel and size of nozzle orifice, Injection in S.I. engine, Battery ignition system, Spark plug, Magneto ignition system, Modern ignition systems, Ignition timing and ignition parameters.
Combustion Chamber: Stages of combustion in S.I. engines, Combustion chambers for S.I. engines, Combustion in C.I. engines, Stages of combustion in C.I. engines, Phenomenon of knock in S.I. and C.I. engines.
Engine Friction And Lubrication: Lubrication of engine components, Lubrication system, Wet sump and dry lubrication, Properties of lubricants.
Measurements and Testing: William`s line method, Morse test, Motoring test, Retardation test, Prony brake, Rope brake, Hydraulic dynamometer, Emission, Fuel consumption, Volumetric type flow meter, Fuel consumption and air consumption measurements, Combustion phenomenon, Performance parameters and characteristics, Two stroke engines, Air pollution due to I.C. engines.

Texts/Reference:

1. V. Ganeshan: I. C. Engines: TMH, 4/e
2. Heywood: Internal Combustion Engine Fundamental: TMH, 1/e
3. W. W. Pulkrabek: Engineering Fundamentals of I. C. Engines
4. M. L. Sharma & R.P. Sharma: A course in I. C. Engines

ME 1432	**GAS DYNAMICS**	L	T	P	C
	(Departmental Elective – II) Seventh Semester	3	0	0	6

(Mechanical Engineering Branch)

Pre-requisite- ME 1206, ME 1302

Concept from Thermodynamics: Thermodynamic systems, variables of state, the first principal law, irreversible and reversible processes, perfect gases, the first law applied to reversible processes. specific Heats, the first law applied to irreversible processes, the concept of entropy. The second law, The cononical equation of state. Free energy and free enthalpy, reciprocity relations, entropy and transport processes, equilibrium conditions, mixtures of perfect gases, The law of mass action, dissociation, condensation, real gases in gas dynamics.
One-Dimentional Gasdynamics: Introduction, the continuity equation, the energy equation, reservoir conditions, Euler's equation. The momentum equation, isentropic conditions, speed of sound; Mach number, the area-velocity relation, results from the energy equation, Bernoulli equation; Dynamic pressure, flow at constant area, the normal shock relations for a perfect gas, Hugonot equation, one-dimentional flow with heat addition, one-dimentional flow with friction.
Oblique shock and expansion waves, source of oblique waves, oblique shock relations, supersonic flow over wedges and cones, shock polar, regular reflection from a solid boundary, pressure-deflection diagrams, intersection of shocks of opposite families, intersection of shocks of the same family, mach reflection, detached shock wave in front of a blunt body, three-dimentional shock waves, Prandtl-Meyer expansion waves, shock-expansion theory, solution of machangle.
Numerical techniques for steady supersonic flow-supersonic nozzle design, method of characteristics for axisymmetric irrotational flow, method of characteristics for rotational (Non-isentropic and non-adiabatic) Flow, introduction to finite differences, Mac-Cormack's technique, boundary conditions, Rayleigh flow, Fanno flow, effects of viscosity and conductivity, measurement in compressible flow.

Texts/Reference:

1. Robert D. Zucker Oscar Biblarz: Fundamentals of gas dynamics: John Wiley & Sons, Inc.
2. John D. Anderson, Jr: Modern Compressible Flow: McGraw-Hill Publishing Company.
3. H. W. Liepmann A. Roshko: Elements of Gas Dynamics: John Wiley & Sons, Inc.
4. E Rathakrishnan: Gas Dynamics: Prentice Hall of India Ltd., New Delhi.

ME 1433	**ROBOTICS AND ROBOT APPLICATIONS**	L	T	P	C
	(Departmental Elective – II) Seventh Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1301, ME 1303, ME 1307, EC 1101, ME 1208

Introduction: Brief History, Types of robots, uses of robots, Present status and future trends in robotics, Overview of robot subsystems.
Issues in designing and controlling robots: resolution, repeatability and accuracy, transmission, Robot configurations and concept of workspace, Mechanisms and transmission.
Robot Anatomy: End effectors and actuators, Different types of grippers: vacuum and other methods of gripping. Pneumatic, hydraulic and electric actuators.
Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder, camera. Micro-controllers, DSP, centralized controllers, real time operating systems.
Task specification: Point to point and continuous motion specifications for typical applications, joint interpolation, task space interpolation, executing user specified tasks
Robot analysis: Position and orientation of rigid bodies, spatial mechanism description, Denavit-Hartenberg notation, homogenous transformation.
Forward and inverse position analysis, velocity mapping, static force analysis, singularities, acceleration mapping.
Robot control: Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, issues in nonlinear control, force feedback, hybrid control
Motion planning: Obstacle avoidance, configuration space, road map methods, graph search algorithms, potential field methods.
Robot vision: Camera model and perspective transformation, image processing fundamentals for robotic applications, image acquisition and preprocessing.
Segmentation and region characterization, object recognition by image matching and based on features, Problem of bin-picking.
Futuristic topics in Robotics: Micro-robotics and MEMS (Micro electro mechanical systems), Fabrication technology for micro-robotics, stability issues in legged robots, under-actuated manipulators
Case studies: Robot in assembly (Puma), Mobile robot (Nataraj)
Texts/Reference:

1. M. P. Groover: Industrial Robotics: Mc Graw Hill Book Co, 2/e
2. Mittal: Robotics & Control: McGraw-Hill
3. Saha: Introduction to Robotics: McGraw-Hill
4. M. P. Groover: Automation, Production systems and Computer Integrated Manufacturing: PHI
5. J. J. Craig: Introduction to Robotics: Addison Wesley
6. S. R. Deb: Robotics Technology and Flexible Automation: McGraw-Hill, 2/e

ME 1434	**HOLISTIC APPROACH TO ENGINEERING DESIGN**	L	T	P	C
	(Departmental Elective – II) Seventh Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1304, ME 1308

Design Process Introduction, The Design Process steps, Detailed Morphology of Design, Considerations in Design, A design example The Engineering designer-tasks and activities, design Process position and trends, Necessity for systematic Design, Historical Background, Current Methods.
Study of processes involved in design realization, problem solving process, Study of different methodologies in problem solving process, analysis, synthesis and communication, Study of different case studies on the various aspects of the problem solving in design.
Ergonomics: Overview of the subject with its design relevant, Man – the primary system, component, Human compatibility, Comfort and adaptability, Physical(Anthropometry), Physiological and psychological (Behavioral acceptance factors) consideration, Principles of fitting design configuration to the users, Determining lay-out component principles, Man machine environment system and user friendly design practice, Stages of design development, Ergonomics design principles and criteria.

Texts/Reference:

1. George E. Dieter: Engineering Design: Mc Graw Hill Book Co.
2. R. C. Mishra Simant: Mechanical System Design: PHI
3. Geoffrey Jordan: System Simulation: PHI
4. Paynee: Introduction to Simulation Programme and Method of Analysis: PHI
5. G. Pahl, W.Beitz, J. Feldhusenm K.H.Grote: Engineering design: Springer

ME 1435	**METAL FORMING & METAL CUTTING TECHNOLOGY**	L	T	P	C
	Seventh Semester (Elective – II)	3	0	0	6

(Mechanical Engineering Branch)
Pre-requisite- ME 1203, ME 1303

Metal Forming: Classification of forming process, Stress, strain and strain rules, laws, Yield criterion and flow rules, effect of parameters such as strain rate, temperature etc, workability, anisotropy. Friction and lubrication in metal forming processes, Indirect compression processes e.g., Drawing and Extrusion processes, Direct compression processes e.g., forming and rolling, Theory of deep drawing, Load bounding techniques and upper bound estimates of field theory, Bending and forming, High-energy rate forming techniques and their applications, Recent advances in metal forming.
Mechanics of Metal Cutting: Tool geometry, Mechanics of orthogonal and oblique cutting, Shear angle relations in orthogonal cutting, Shear angle and chip flow direction in oblique cutting, Chip control methods, Analysis of cutting process, Machining with rotary tools, Thermodynamics of chip formation, Machining at super high speeds, Theories of tool wear, Basic action of cutting fluids, tool life, Factors governing tool life, Machinability-definition and evaluation.
Economics of Metal Cutting: Single and multipass machining operations, Criteria, variables, and restrictions for the economical conditions.
Dynamic metal cutting: Comparison of steady and dynamic process, Shear angle and force relationships, Grinding mechanics, Wheel characteristics and theory of wheel wear, Lapping, Honning, High speed grinding theory, Grinding of drills, form cutters etc., Problems associated with machining of plastics, Tools for plastic cutting,

Texts/Reference:

1. G K Lal: Introduction to Machining Science: New Age International
2. P K Mishra: Non-Conventional Machining: Narosa Publishing House
3. G. C. Sen and A.Bhattacharya: Principles of Metal Cutting/Principles of Machine Tools: New Central Book Agency, Kolkata.
4. Production Technology:: HMT Publication: TMH
5. A.Ghosh and A.K.Mallik: Manufacturing Science: Wiley Eastern.
6. K. Jain: Manufacturing Engineering Technology: Pearson Education
7. P. N. Rao: Manufacturing Technology: Foundry, Forming and Welding: TMH.
8. De Garmo et al.: "Materials and Processes in Manufacturing", Prentice Hall of India, Eight Edition, 1998.
9. Richara R. Kibbe, John E.Neely, Roland O. Meyer and Warrent T. White: Machine Tool Practices:, Prentice Hall of India, VI Edition, 1999.
10. N. K. Mehta: Machine Tool Design and NC: , Tata McGraw Hill Publishing Co. Ltd., 3/e 1999.

ME 1436	**MECHANICS OF COMPOSITE MATERIALS**	L	T	P	C
	(Departmental Elective – II)	3	0	0	6

Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1204

Introduction: Classification of composite materials; Fibrous, laminated and particulate composites; Applications of composite materials.
Fabrication of Composite Materials: Properties of composite fibres; Fabrication of composites with thermosetting and thermo-plastic resin matrices, metal matrix and ceramic matrix; Experimental characterization of composites, such as uniaxial tension and compression, in-plane shear and bending strength, inter-laminar shear strength and fracture toughness; Damage identification using non-destructive techniques.
Macro mechanical behavior of lamina: Stress-strain relations, engineering constants for orthotropic materials, transformation of stress and strain, strength and stiffness of an orthotropic lamina; Biaxial strength theories.
Micromechanical behavior of lamina: Introduction, Volume and mass fractions, density and void content, Evaluation of elastic moduli,role of mixtures, ultimate strengths of a unidirectional lamina, coefficients of moisture expansion.
Macro mechanical behaviour of laminate: Single layered configurations, symmetric laminates, anti symmetric laminates; Strength of laminates; Inter laminar stresses, Hygrothermal analysis of both lamina as well as laminates.

Texts/Reference:

1. Budynas: Advance Strength & Applied Stress Analysis: McGraw-Hill, 2/e
2. Kaw A. K: Mechanics of Composite Materials: CRC press
3. I. M. Daniel and O. Ishai: Engineering Mechanics of Composite materials: Oxford University Press

ME 1437	**ADVANCED FLUID MECHANICS**	L	T	P	C
	(Departmental Elective – II)	3	0	0	6

Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1207, ME 1302

Review of Basic Fluid Mechanics, Navier-stokes equations. Potential flow theory flow around bodies, cylinders and aerofoils, Prediction of velocity and pressure distribution, boundary layer concepts, laminar and turbulent boundary layers, separation criterion, introduction to compressible flow. Velocity of sound and mach number, isentropic flow, flow with friction and heat transfer, analysis of flows with normal & oblique shock waves. Hydraulic machines, classifications, theories & applications.

Texts/Reference:

1. Pati: Textbook of Fluid Mechanics & Hydraulic Machines: McGraw-Hill, 1/e
2. Som & Biswas: Introduction to Fluid Mechanics and Fluid Machines: McGraw-Hill, 3/e
3. Cengel: Fluid Mechanics:, McGraw-Hill, 2/e
4. White: Fluid Mechanics: McGraw-Hill, 7/e
5. Streeter: Fluid Mechanics: McGraw-Hill, 9/e
6. Subramanya: Hydraulic MachinesMcGraw-Hill: 1/e
7. Pati: Textbook of Fluid Mechanics & Hydraulic Machines: McGraw-Hill, 1/e
8. Som & Biswas: Introduction to Fluid Mechanics and Fluid Machines: McGraw-Hill, 3/e,

ME 1471	**FINITE ELEMENT METHOD**	L	T	P	C
	(Open Elective – I)	3	0	0	6

Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1209, ME 1309, MA1101, MA1102, MA1201

Introduction, historical background, applications, advantages, finite element softwares. Theory of elasticity - stress and equilibrium, stress-strain relationship, strain-displacement, relationship, plane stress, plane strain and axi-symmetric approximation. Temperature effects. Potential energy and equilibrium, Principle of minimum potential energy. Discrete and Continuous systems, Rayleigh-Ritz method, Galerkin method. Solution of Algebraic equations, Banded and skyline solutions. Global, Local and Natural coordinates in 1, 2 and 3 dimensions - Area coordinates. Numerical Integration using Gauss quadrature. Finite element modeling - types of elements, Discretization, Mesh generation and numbering. Shape functions - types and properties.
Iso parametric formulation. Largrangean and Serendipity elements.
One dimensional elasticity problems - discretisation of domain into elements – generalized coordinates approach - derivation of elements equations - assembly of element equations - transformation matrices - global equations, load vector, properties of stiffness matrices, imposition of Boundary conditions - penalty and elimination approach, multi-point constraints. Finite element formulation of plane trusses, beams and beams on elastic supports.
Finite element formulation of 2D problems using constant strain triangle element and isoparametric quadrilateral element. Axi-symmetric solids subjected to axi-symmetric loading. Features of 3D problems in stress analysis. Scalar field problems - one dimensional heat conduction through composite walls and fins, potential flow. Dynamic problems- Hamilton's principle, Mass matrices, lumped and consistent formulations.

Texts/Reference:

1. Reddy: An Introduction to Finite Element Method: McGraw-Hill, 3/e
2. Hutton: Fundamentals of Finite Element Analysis: McGraw-Hill, 1/e
3. Krishnamoorthy: Finite Element Analysis: Theory and Programming: McGraw-Hill, 2/e,
4. T. K. Chandrupatla and A. D. Belegundu: Introduction to Finite Elements In Engineering: Prentice Hall of India Pvt. Ltd., New Delhi
5. S. Rajasekaran: Finite Element Analysis in Engineering Design: Wheeler Publishing,
6. K. S. Bathe & E. L. Wilson: Finite Element Method: Prentice Hall of India
7. R. D. Cook: Concepts and Applications of Finite Element Analysis: Wiley.

ME 1472 **PROJECT MANAGEMENT** L T P C

(Open Elective – I) 3 0 0 6
Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- HS 1201, HS 1301

Project Planning: Project Management scenario, Project Asset – issues & problems, Gantt Chart & LOB, Network Analysis, PERT / CPM, Resource Monitoring & Control.
Contract Management: principles of Project Contracts, compilation of Project Contracts, practical aspects of Contract, legal aspects of Project Management, global tender, negotiations for Projects, insurance for Projects.
Project Buying: Projects Procurement Process, Life – cycle Costing, Project Cost Reduction methods, Project Stores, organization & HRD issues, Computerization.
Investment Feasibility Studies: managing Project Resources Flow, Project Feasibility studies, Project Cost – Capital & Operating , Forecasting Income, Estimation of Investment & ROI, Project Evaluation, Financial Sources, Appraisal Process.
Issues in Project Management: Project Audit, Project Monitoring & MIS, Cost Control, Real Time Planning, Intangibles.
Project Management: Case Studies.

Tests/Reference:

1. Chandra: Projects: McGraw-Hill, 7/e
2. Chitkara: Construction Project Management: Planning, Scheduling and Control (With CD): McGraw-Hill, 2/e
3. Gray: Project Management: The Managerial Approach (SIE): McGraw-Hill, 4/e,
4. P Gopalkrishnan & V E Ramamurthy: Text Book of Project Management: McMillan.
5. N Singh: Project Management & Control: Himalaya
6. V Desai: Project Management:
7. B M Patel: Project Management: Vikas.

ME 1473 **RELIABILITY ENGINEERING** L T P C

(Open Elective – I) 3 0 0 6
Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1208, MA1101, MA1102, MA1201

*Reliability Concept***:** Reliability and probability, Maintainability and availability, The tasks of reliability, Decision making and failure statistics, Failure probability, Survival probability and age specific future rate, Weibull pdf, Application of failure statistics to reliability prediction for complex plants, Plant availability assessment, Stand- by systems, Multi unit stand-by systems, Derating and maintenance, Reliability testing, Accelerated testing, Sequential testing project management, Human reliability, Super reliability, Safety factor and reliability, Reliability allocation, Effects of environment in reliability assessment, Solutions of reliability to a variety of real engineering problems, Making, Installation and use of computers, Programming, Management prospective.

Texts/Reference:

1. Balaguruswamy E: Reliability Engineering: TMH
2. Ebeling: An Introduction to Reliability and Maintainability Engineering: McGraw-Hill, 1/e
3. Birolini A: Reliability Engineering - Theory and Practice: Springer

ME 1474 **ENVIRONMENTAL POLLUTION AND ITS CONTROL** **L T P C**

(Open Elective – I) **3 0 0 6**
Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- CH 1101, ME 1307

Causes effects and control measures- air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear pollution, solid waste management, causes, effects and control measures of urban and industrial wastes, pesticides pollutions, air pollution – SOx, NOx, CO, particulates Solid and water pollution, formation of pollutants, measurement and controls; sources of emissions, effect of operating and design

parameters on emission, control methods, exhaust emission test, procedures, standards and legislation; environmental audits; emission factors and inventories, global warming. CO_2 emissions, impacts, climate change, global warming, acid rain, ozone layer depletion, laws related to environmental pollution.

Texts/Reference:

1. Cunninghum: Principles of Environmental Science: Inquiry & Applications: (by McGraw-Hill, Special Indian Edition), 4/e
2. Keily: Environmental Engineering: McGraw-Hill, (Special Indian Edition),1/e
3. K.P. Srivastava: An Introduction to Environmental Study: Kalyani Publishers, Ludhiana
4. J.A. Nathanson: Basic Environmental Technology: Prentice Hall of India, New Delhi.
5. A. R. W. Jackson and J.M. Jackson: Environmental Sciences: The Environment and Human Impact: Longman Publishers.
6. J. A. Nathanson: Basic Environmental Technology: PrenticeHall of India, New Delhi

ME 1475	**MECHATRONICS**	**L**	**T**	**P**	**C**
	(Open Elective – I)	**3**	**0**	**0**	**6**

Seventh Semester
(Mechanical Engineering Branch)

Pre-requisite- EE 1101, EC 1101, ME 1301, ME 1304, ME1308

Introduction: Definition – Trends - Control Methods: Standalone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.
Signal Conditioning: Introduction – Hardware - Digital I/O, Analog input – ADC, resolution, speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering
Precision Mechanical Systems: Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.
Electronic Interface Subsystems: TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers, over current sensing, resetable fuses, thermal dissipation - Power Supply - Bipolar transistors / mosfets
Electromechanical Drives: Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives, PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.
Microcontrollers Overview: 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming – Assembly, C (LED Blinking, Voltage measurement using ADC).
Programmable Logic Controllers: Basic Structure - Programming: Ladder diagram - Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.
Programmable Motion Controllers: Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices: Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive, Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P, PI, PID Control - Control modes – Position, Velocity and Torque - Velocity Profiles – Trapezoidal - S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear, Circular - Core functionalities – Home, Record position, Go to Position - Applications : SPM, Robotics.

Texts/Reference:

1. Mahalik: Mechatronics: McGraw-Hill
2. W Bolton: Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering: Pearson Education Press, 3rd edition, 2005.
3. M.D.Singh/J.G.Joshi: Mechatronics: PHI.
4. Newton C Braga: Mechatronics Source Book: Thomson Publications, Chennai.
5. N. Shanmugam / Anuradha: Mechatronics: Agencies Publisers.
6. Devdas shetty/Richard: Mechatronics System Design: Thomson

ME 1403	**COMPUTER AIDED DESIGN AND MANUFACTURING**	L	T	P	C
	Eighth Semester	3	0	0	6
	(Mechanical Engineering Branch)				
	Pre-requisite- ME 1303, ME 1301, ME 1401				

Introduction: Introduction to CAD/CAM, need of CAD/CAM, product cycle, automation in CAD/CAM and CAD/CAM integration.
Computer Aided Design: Computer graphics, principles of geometric modeling, transformations, wire frame, surface and solid modeling, Rapid Prototyping and tooling.
Group Technology (GT): Introduction, part families, parts classification and coding systems, GT machine cells, benefits of GT.
Process Planning: Basic concepts of process planning, computer aided process planning (CAPP), Retrieval or variant and generative approach of CAPP, Implementation consideration of CAPP.
Numerical Control of Machine Tools: Principles of Numerical control (NC), Computer Numerical control (CNC), Direct Numerical control (DNC), comparison between conventional and CNC systems, Classification of CNC system, NC coordinate system, positional control, system devices, interpolators, adaptive control system.
NC Part Programming: Concept, format, preparatory and miscellaneous codes, manual part programming, APT programming.
FMS and CIM: Introduction to flexible manufacturing system (FMS), the manufacturing cell, tool management and workpiece handling system, transfer lines, types and application of industrial robots, end effectors and grippers of robots, types of manufacturing systems, components of computer integrated manufacturing (CIM), hierarchical computer system, benefits of CIM.

Texts/Reference:

1. Mehta: Machine Tools Design and Numerical Control: McGraw-Hill, 3/e,
2. Yoram Koren: Computer control of manufacturing system: Mc Graw Hill Book Co.
3. B. L. Jones: Computer Numerical Control: John Wiley and Sons.
4. Chen and Lin: Computer Numerical Control: Glory Educational Resource Inc.
5. Rao, Tiwari and Kunda: Computer Aided Manufacturing: Tata Mc Graw Hill
6. Groover and Zimmer: CAD/CAM: PHI
7. Groover: Automation, Production Systems and Computer Integrated Manufacturing: PHI
8. Chang, Wysk and wang: Computer Aided Manufacturing: PHI

ME 1441	**DIAGNOSTIC MAINTENANCE OF MECHANICAL EQUIPMENTS**	L	T	P	C
	(Departmental Elective-III)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				
	Pre-requisite- ME 1208, ME 1473				

Introduction: Unplanned and planned maintenance – objectives of planned, preventive and predictive maintenance – conditioned based maintenance and signature analysis, concept of reliability, Availability and maintainability, Fault analysis planning – failure mode and effect analysis, fault tree analysis, case studies, applications in industry.
Maintenance: Basic definitions, preventive, operating and shutdown maintenance, level of maintenance, factor influencing Preventive Maintenance, data processing technique, focus on implementing with examples, measuring maintenance effectiveness and maintenance control.
Non destructive testing: Its importance, testing to maintenance, principal methods- dye penetrant, magnetic particle testing and ultrasonic tests, Tero- technological approach to maintenance.
Fluid Condition and Contaminant Analysis: Carrier fluid degradation, spectroscopy and spectrometric oil analysis procedure, Ferrography, Magnetic Chip detection.
Visual testing, Liquid Penetrant inspection, X-ray photography, Application of ultrasonic and acoustic emission for fault detection.
Wear: Different types of wear and technique for minimisation of wear with examples . Diagnostic Data processing and decision making, statistical distribution, approach to automated data processing, pattern recognition, Neural network and expert system, case studies.

Texts/Reference:

1. B. C. Majumdar: Introduction to Tribology of Bearings: A. H. Wheeler & Co. Ltd
2. A. Cameron and C. M. Mc Ettles: Basic Lubrication Theory: Wiley Eartern Ltd., New Delhi
3. S. Branned: Mechanical Signature Analysis: Theory and Application: Academic Publishers, London

4. B. C. Nakra and K. K. Chaudhary: Instrumentation measurements and Analysis: Tata Mcgraw Hill Publishing company
5. Sushil Kumar Srivastava: Maintenance Engineering and Management: S. Chand & Company Ltd, NewDelhi
6. R. C. Mishra and K. Pathak: Maintenance Engineering and Management: Prentice Hall of India, New Delhi
7. Gowda: Vibration: McGraw-Hill

ME 1442	**MECHANICAL VIBRATIONS**	L	T	P	C
	(Departmental Elective-III)	3	0	0	6

Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1101, ME 1202, ME 1301

Introduction: Basic Concepts, Classification of Vibrations and vibrating Systems, Importance and scope ,Free and forced Vibrations, Linear and Non linear Vibrations, Deterministic and random Vibrations, Elementary Parts Of Vibrating Systems, Examples of harmonic motion, Periodic motion, Discrete and Continuous Systems,
Single Degree Of Freedom System:
Free vibration Undamped – D.Alembert`s principle and energy method, Natural frequency, Response of equivalent systems and torsional systems. Energy method, Rayleigh's Method.
Damped Free vibration with viscous damping – Logarithmic decrement ,torsion System with Viscous damping, Free vibration with Coulomb damping, damped torsional vibrations, Equivalent Viscous damping, overdamped, critically damped and underdamped vibration.
Forced Vibration: Undamped Systems and Damped Systems, Steady state forced vibration, Source of excitation, Impressed harmonic force due to imbalance and motion excitation, Rotating and reciprocating imbalance, Whirling of Rotating Shafts, Vibration Isolation and Force Transmissibility, Response of vibrating Systems under Coulomb and hysteresis damping, Vibration Measuring instruments, Accelerometer and vibrometer.'
Two Degree of Freedom System: Free vibrations of Undamped Systems, torsional Systems, Coordinate Coupling and Principal Coordinates, damped free Vibrations, Forced vibrations of Undamped Systems, Forced vibrations with harmonic excitation, Dynamic Vibration Absorber, Orthogonality principle, Generalized co-ordinates
Multi degree of Freedom System: Undamped free vibration of multidegree of freedom system, Classical method, flexibility influence coefficients and stiffness Influence coefficients, Stiffness matrix, Matrix iteration method, Adjoint of Matrix Method, Orthogonality Principle, Analysis of multi degree of freedom system by numerical method, Rayleigh`s upper bound approximation and Dunkerley`s lower bound approximation.
Critical speed of shafts: Whirling of uniform shaft, Critical speed of a light shaft with single disc without Damping, Critical speed of shaft with multiple discs, Secondary critical speed.

Texts/Reference:

1. Gowda: Mechanical Vibrations: McGraw-Hill, 1/e
2. Kelley: Mechanical Vibrations (SIE) (Schaum's Outline)
3. I.E. Morse And Hinkle: Mechanical Vibration- theory & application: CBS Publishers New Delhi
4. W. T. Thomson: Theory of Vibration with Application: CBS Publishers New Delhi
5. G. K. Grover: Mechanical: New Chand & Brothers, Roorkee
6. K. Pujaria: Vibration and Noise For Engineers: Dhanpat Rai & Sons
7. J. S. Rao & G. K.Guptam: Introductory Courses On Theory And Practice of Mechanical Vibration: Willey Eastern Publishing Ltd
8. Rao V. Dukkipati, J. Srinivas: Mechanical Vibrations: Prentice Hall India
9. R. K. Singal: Mechanical Vibrations: S. K. Kataria & Sons

ME 1443	**COMPRESSOR AND GAS TURBINES**	L	T	P	C
	(Departmental Elective-III)	3	0	0	6

Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1206, ME 1302, ME 1306, ME 1402

Gas Turbine Cycles: Analysis of closed and open cycles gas turbines, thermal refinement of gas turbine cycles, regeneration, reheating and intercooling, comparison between open and closed cycles gas turbines, combined steam and gas turbine cycle and its analysis**.**
Propulsion systems: Various types of propulsion devices, turbojet, turboprop and Ram jet engine, thrust power, propulsion efficiency, overall efficiency, effect of altitude, thrust augmentation, rocket propulsion ,liquid propellant and solid propellant rocket engines, uses of rocket propulsion devices.

Principles of rotating machines: General energy equation, review of concept of of static and stagnation head properties, review of concept of aerofoil theory, flow and pressure distribution over aerofoil sections.
Centrifugal compressor: Basic components, working principle, velocity triangle, enthalpy-entropy diagram, slip, power input factor, compressor efficiency, pressure coefficient, flow coefficient, degree of reaction, pre-whirl, effect of impeller blade shape on performance, vaned and vaneless diffuser, phenomenon of surging and choking.
Axial compressor: Basic components, principle of working, velocity triangle, enthalpy-entropy diagram, work done factor, degree of reaction, polytropic efficiency, pressure coefficient, flow coefficient, compressor stalling.
Axial and radial flow turbines: Enthalpy-entropy diagram, turbine and nozzle efficiencies, blade speed ratio, velocity ratio and torque, velocity compounded turbine, reaction turbine, reheat factor, working principle of radial flow turbine, comparison of turbine types.
Gas turbine fuels and combustion chamber: Fuels for gas turbines, combustion mechanism, combustion efficiency, combustion chamber requirements, types of combustion chambers, combustion chamber pressure loss.
Gas turbine blade materials: Different blade materials for gas turbine, factors influencing the selection of blade materials, cooling of blades, different types of cooling.
Performance of gas turbine power plants and its application in different fields: Performance characteristics of compressor and turbine, matching of components, equilibrium running diagram, application of gas turbines in different field

Texts/Reference:

1. By Ganesan: Gas Turbine: McGraw-Hill Education, 3/e:
2. S.M. Yahya: Turbines, Compressors and Fans: Satyaprakashana Publishers, New Delhi, 4/e
3. H Rogers: Gas turbine theory: Pearson education
4. Khajuria and Dubey: Gas turbine and Propulsive Systems: DhanpatRai and Sons

ME 1444	**CONVECTIVE HEAT AND MASS TRANSFER**	L	T	P	C
	(Departmental Elective-III) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1207, ME 1302, ME 1309, ME1471

Conservation equations and boundary conditions, One-dimensional solutions, Heat transfer in laminar developed and developing duct flows, Laminar boundary layers, Similarity and integral solutions, Turbulence fundamentals and modeling, Heat transfer in turbulent boundary layers and turbulent duct flows, Laminar and turbulent free convection, Fundamentals of boiling and condensation, Numerical methods.

Text/Reference:

1. W. M. Kays & E. M. Crawford: Convective Heat & Mass Transfer: McGraw-Hill
2. Louis C Burmeister: Convective Heat Transfer

ME 1445	**PRODUCTION PROCESSES**	L	T	P	C
	(Departmental Elective-III) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1203, ME 1303, ME 1307

Producibility, Automation and Design principles: Processes, Costs and Producibility, Automation and Design principles, Design for Assembly, Measuring and Gauging Parts, Design for N/C, Design for recycling.
Metal Removal Methods: Flame Cutting, Contour Sawing, Planing, Shaping and Slotting, Automatic and Shape Turning, Turret Lathe Machining, Automatic Bar and Chucking Machining, Swiss Automatic Machining, Production Milling, Drilling and Boring, Hobbing, Broaching, Gear Shaper Generating, Abrasive Belt Grinding, Production Grinding, Mass finishing, Honing, Lapping, Super finishing.
Metal Forming Methods: Metal Spinning, Brake Forming, Roll Forming, Section Contour Forming, Stamping, Deep Drawing, Rotary Swaging and Hammering, Wire Forming.
Metal Working and Forging Methods: Die forging, Hot Upsetting, Die Rolling, Hot Extrusion, Cold and Impact Extrusion, Cold Drawing, Cold Heading, Thread and Form Rolling.
Metal Deposition Methods: Electroforming, Metal Spraying.
Casting Methods: Sand Casting, Permanent Mould Casting, Centrifugal Casting, Die Casting, Plaster Mould Casting, Investment Casting.
Moulding Methods: Powder Metallurgy, Plastic Moulding, Rubber Moulding, Ceramic Moulding.
Fabrication Methods: Welding, Spot Welding, Seam Welding, Projection Welding, Butt Welding, Brazing.

Treating Methods: Heat Treating Steels, Heat Treating Non-ferrous Metals, Shot Peening.
Unconventional Methods: Chemical Machining, Electric Discharge Machining.
Finishing Methods: Drawing Finish Notes, Cleaning, Powder Brushing, Polishing and Buffing, Painting and Coating.

Texts/Reference:

1. Rozer William Bolz: Production Processes: The Productivity Hand BookL 5th Edition, Industrial Press Inc.
2. Parashar, B.S. Nagendra, Mittal, R. K: Elements of Manufacturing Processes: PHI
3. NIIT: An Introduction to Engineering Materials and Manufacturing Processes: PHI
4. Kaushish: Manufacturing Processes: PHI, 2/e
5. P.C. Pandey and H.S. Shah: Modern Machining Process: Tata McGraw Hill
6. Lindberg: Process and Materials of Manufacture:– PHI, 4th Ed
7. Degramo, Kohser and Black: Materials and Processes in Manufacturing: PHI, 8th Ed
8. Amstead Ostwald, and Bageman: Manufacturing Processes: John Wiley and sons.
9. HMT: Production Technology

ME 1446	**TOTAL QUALITY MANAGEMENT**	L	T	P	C
	(Departmental Elective-III)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME 1401, ME 1425

Introduction: Definition of TQM, Principles of TQM, operational model, TQM system, organization, structure for TQM.
World Class Quality & TQM: Customer focus, strategic quality planning, executive leadership, managing for quality, outcome & financial gains; measurement & management – prescriptive to Realistic approach; improved measurement systems.
Tools & techniques: 5-S campaign, TQC, Total employee involvement (TEI), problem–solving process, Quality Circles (QC), statistical tools in quality control, quality function deployment (QFD); House of quality – product planning matrix, Taguchi technique, failure mode & effect analysis (FMEA), Poka-Yoke, Kaizen, PDCA cycle.
Process capability, Just- in -time (JIT) & TQM: quality production through JIT & Kanban, JIT methods – Waste & its elimination, Jidoka, TPM, TQM Implementation barriers, Total Customer Satisfaction (TCS), Implementing TQM – Case studies
Evaluation of standards & ISO-9000 series of standards: History of standards, ISO-9000 series of standards, structure of ISO-9000 series, Benefits of ISO-9000 series.
ISO-9001 Quality Management System: Management responsibility, quality system, contract review, design control, document & data control, product identification & traceability, process control, inspection & testing, control of non-conformity products, corrective & preventive action. Quality records, quality audits, training, servicing

Texts/Reference:

1. Grant: Statistical Quality Control: McGraw-hill, 7e
2. Jivan: Quality Planning & Analysis
3. Feigenbaum AV: Total Quality Control
4. Ishikawa: What is TQC
5. R. P. Mohanty & R R Lakhe: Hand book of TQM

ME 1447	**EXPERIMENTAL STRESS ANALYSIS**	L	T	P	C
	(Departmental Elective-III)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME 1208, ME 1209, ME 1423, ME 1427

Strain Analysis Methods: Three element rectangular strain rosette, correction, stress gauges,
over-deterministic methods for strain analysis, residual stress determination Applications: Application of strain gauges for measurement of load, temperature, pressure, vibration, stress and strain etc.
Optical Methods of Stress Analysis: Basic of Optics, Optical Instrumentation Moire Fringe
technique-theory and experimental procedures, Fractional fringe measurement- Tardy's Method , Babinet Soleil Method.

Theory of Photoelasticity: Polariscope- Plane polariscope, Circular polariscope, Different Arrangements photoelastic photography, Photoelastic materials-properties, selection, casting methods, calibration. Analysis Techniques-Determination of direction of Principal stresses at given point, Determination of exact fringe order N and the principal stress Separation methods, Method based on Hooke's Law, Electrical analogy method, Oblique incidence method, Shear difference method, Scaling model results to prototype Application of photoelasticity to 2-D and 3-D Stress analysis
Optical methods for Determining Fracture Parameters: Irwins methods, application. of moiré and isopachic fringe pattern to determine stress intensity factor, mixed mode intensity factors
Coating Techniques: Bifringent coating- stress-optic and strain-optic relation, sensitivity and coating materials, fringe order determination. Brittle coating technique. Strategy.
Holography: Plane and spherical waves - coherence - holographic setup – Interferometry -Displacement measurement - obtaining Isopachics,

Texts/Reference:

1. Budynas: Advance Strength & Applied Stress Analysis: McGraw-Hill, 2/e
2. R. S. Sirohi, HC Radhakrishna: Mechanical Measurements: New Age International (P) Ltd. 1997
3. F. K Garas, J.L. Clarke and GST Armer: Structural Assessment: Butterworths, London, 1987
4. Dove and Adams: Experimental Stress Analysis and Motion Measurement: Prentice Hall of India, 1965
5. Sadhu Singh: Experimental Stress Analysis: Khanna Publishers, New Delhi, 1996

ME 1451	**COMPUTATIONAL FLUID DYNAMICS**	L	T	P	C
	(Departmental Elective-IV)	3	0	0	6

Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1207, ME 1302, ME 1309, CS 1101, MA1101, MA1102, MA1201

Goals of CFD; Problem definition and sources of error; Spatial discretization- interpolation and function approximation, method of weighted residuals for function approximations, Fourier (spectral) interpolation and function approximation, derivatives of functions, finite volume and finite difference schemes for linear/non linear & incompressible/compressible flows; Solution of systems of equations- classical iterative techniques, introduction to multigrid, basic convergence analysis; Navier-Stokes equations- Discretization methods and grids, performance metrics, designing methods, pressure in incompressible flow, implicit convection, specific methods for incompressible flow- fractional step, stream function /vorticity form; turbulence modelling

Texts/Reference:

1. Anderson: Computational Fluid Dynamics: McGraw-Hill Publisher
2. Wendt, John F: Computational Fluid Dynamics: Springer Verlag publication, 3rd Ed
3. Joel H. Ferziger & Milovan Peric: Computational Methods for Fluid Dynamics: Springer Verlag publication
4. S. Patankar: Numerical Heat Transfer and Fluid Flow: Taylor & Francis publication
5. P. Niyogi, S. K. Chakrabartty & M. K Laha: Introduction to Computational Fluid Dynamics: Pearson publication

ME 1452	**ENERGY ENGINEERING AND MANAGEMENT**	L	T	P	C
	(Departmental Elective-IV)	3	0	0	6

Eighth Semester
(Mechanical Engineering Branch)
Pre-requisite- ME 1206, ME 1309, ME 1402

Trends in energy use patterns, energy and development linkage. Energy economics – simple payback period, time value of money, IRR, NPV, life cycle costing, cost of saved energy, cost of energy generated, examples from energy generation and conservation, importance of energy management. Energy audition: methodology, analysis of past trends plant data, closing the energy balance, laws of thermodynamics, measurements, portable and on line instruments. Energy economics – discount rate, payback period, internal rate of return, life cycle costing. Steam systems: Boiler – efficiency testing, excess air control, steam distribution & use steam traps, condensate recovery, flash steam utilization. Thermal Insulation. Electrical systems: Demand control, power factor correction, load scheduling/shifting, motor drives motor efficiency testing, energy efficient motors, motor speed control. Lighting – lighting levels, efficient options, fixtures, daylighting, timers, energy efficient windows. Energy conservation in pumps, fans (flow control), compressed air systems, refrigeration & air conditioning systems. Waste heat recovery: recuperators, heat wheels, heat pipes, heat pumps. Cogeneration-concept, options (steam/gas turbines/diesel engine based), selection criteria, control strategy. Heat exchanger networking-concept of pinch, target setting, problem table approach, composite curves. Demand side management. Financing energy conservation.

Texts/Reference:

1. World energy assessment: Energy and the Challenge of Sustainability: UNDP, New York
2. A. K. N. Reddy, RH Williams, TB Johanson,: Energy after Rio, Prospects and challenges: UNDP, United Nations Publication, New York, 1997
3. Arnulf Grubler and Alan McDonald edited by Nebojsa Nakicenovic: Global energy perspectives: Cambridge University Press, 1998

ME 1453	**ADVANCED MACHINING PROCESSES**	L	T	P	C
	(Departmental Elective-IV) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1303, ME 1307

Introduction, characteristics, and need of advanced machining processes, classification.
*Mechanical Processes:*Abrasive Jet Machining (AJM) – Operating principle, equipments, process parameters, applications and limitations.
Ultrasonic Machining (USM) – Working principle, equipments, transducers, amplifications, concentrator, feed mechanism, acoustic head clamping, process parameters, applications and limitations.
Water Jet Machining (WJM) – Operating principle, equipments, process parameters, applications and limitations.
Abrasive flow machining (AFM) - Working principle, equipments, process capabilities and applications.
Chemical Processes: Chemical Machining (CHM) – Operating principle, equipments, applications and limitations.
Electrochemical Machining (ECM) – Operating principle, equipments, power supply and control, tool design, process parameters, applications and limitations.
Electrothermal Processes: Electrical Discharge Machining (EDM) – Operating principle, electrode materials, dielectric fluid, gap flushing, equipments, different EDM operations, power generator, WEDM, process parameters and their effects, applications and limitations.
Laser Beam Machining (LBM) – Laser fundamentals and the industrial lasers, lasing materials, processing with lasers, machining applications of laser.
Electron Beam Machining (EBM) – Process, equipments, process parameters, applications and limitations.
Plasma Arc Machining (PAM) –Principle of plasma arc, plasma arc torches, process parameters, advantages and disadvantages.
Ion Beam Machining (IBM) – Process, beam source, ion guns, IBM setup, operating principle, process parameters, applications.

Texts/Reference:

1. Pandey: Modern Machining Process: McGraw-Hill
2. G. F. Benedict, Marcel Dekker Inc: Nontraditional Manufacturing Processes
3. P. K. Mishra: Nonconventional Machining: Narosa Publishing House
4. A. Ghosh & A. K. Mallik: Manufacturing Science: Affiliated East-West Press Pvt. Ltd.
5. G. Boothroyd & W.A. Knight: Fundamentals of Machining and Machine Tools: CRC Press, Taylor & Francis Group
6. J. A. McGeogh: Advanced Methods of Machining: Chapman & Hall

ME 1454	**AIR CONDITIONING**	L	T	P	C
	(Departmental Elective-IV) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite-ME 1206, ME 1421

Psychometry & Psychrometric Processes: Psychrometric properties, Representation of psychrometric properties in charts, Preparation of psychrometric chart, Constant sensible and latent heat processes, Adiabatic saturation, Adiabatic mixing of air streams, Air-Washer, Sensible heat factors, Apparatus dew point, By pass factor, Humidifying efficiency.
Load Calculations: Inside and outside design conditions, Load classification, Summer cooling loads, Introduction to the methods of calculating cooling load and heating load.
Comfort Air conditioning: Various comfort indices, Effective temperature, Parameters governing human comfort, Comfort charts and its limitation.

Duct Design And Air Distribution: Pressure drop calculation for various types of duct, Enlargements, Contractions, Branch tube- offs etc., Duct design methods – velocity deduction, equal friction and static regulation, Duct design procedure – dynamic loss coefficient method, equitable length method, air distribution system in rooms, supply and return grills, Air distribution terminology.
Air Conditioning Systems: Central and unitary air conditioning, Special features of residential, commercial and industrial air conditioning system, Year round air conditioning.

Texts/Reference:

1. C.P. Arora: Refrigeration and Air conditioning
2. M. Prasad: Refrigeration and Air conditioning
3. Stocker & Jones: Refrigeration and Air conditioning
4. Jordan & Preister: Refrigeration and Air conditioning
5. P.N. Ananthanarayan: Refrigeration and Air conditioning
6. S.K. Kulshrestha: Refrigeration and Air conditioning
7. ASHRAE: ASHRAE Hand Book of Fundamentals
8. M. Prasad: Refrigeration and Air conditioning Data Book
9. W. Jones: Air Conditioning

ME 1455	**DESIGN OF MECHANICAL SYSTEMS**	L	T	P	C
	(Departmental Elective-IV) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1304, ME 1308, ME 1401, ME 1434

Engineering process and system approach: Basic concepts of systems,Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, concurrent Engineering.
Problem Formulation: Nature of engineering problems, Need statement, hierararchial nature of problem environments, problem scope and constraint.
A case study: Heating duct insulation system, High speed belt drive system.
System theories: System analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study – automobile instrumentation panel system.
System Modelling: Need of modelling, model types and purpose, linear systems
Mathematical modeling, concepts, A case study compound bar system.
Graph modeling and analysis: Graph modeling and analysis process, path problem, Network flow problem,
A case study: Material handling concept.
Optimization concepts: Optimisation processes, selection of goals and objectives – criteria, methods of optimization, analytical, combinational, subjective.
A case study: Aluminium extrusion system.
System evaluation: Feasibility assessment, planning horizon, time value of money, Financial Analysis.
A case study: Manufacture of maize starch system.
Calculus Method for optimization: Model with one decision variables, model with two decision variables, model with equality constraints , model with inequality constraints,
A case study: Optimization of an insulation system.
Decision Analysis: Elements of a decision problem, decision making, under certainity, uncertainity and conflict probability, density function, expected monetary value, utility value, Bayes theorem.
A case study: Installation of machinery.
System simulation: Simulation concepts, simulation models, computer application in simulation, simulation process, problem definition, input model construction and solution, limitation of simulation approach.
A case study: Inventory in production plant.

Texts/Reference:

1. Ullmann: Mechanical Design Process: McGraw-Hill, 4/e
2. D D Reredith, KV Wong, RW Woodhead, and Rrworthman: Design and planning of engineering systems: Prentice hall inc: Eagle wood cliffs, New Jersey
3. J R Dixon: Design Engineering: New Delhi.
4. S S Rao: Optimization technique
5. Divid I Cleland, William R kind: System Analysis and project management: McGraw Hill.
6. Robert Matousck: Engineering Design: Blackie and son ltd., Glasgow.

ME 1456 **TRIBOLOGY** L T P C

(Departmental Elective-IV) 3 0 0 6
Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1204, ME 1301, ME 1308

Introduction: Historical background and introduction to Tribology of bearings.
Properties and Testing of Lubricants: Types of lubricants and their properties, Viscometry.
Basic equations: The generalized Reynolds Equation, Continuity Equation, Energy Equation
Idealized Hydrodynamic Bearings: Mechanism of Pressure Development, Plane slider Bearing, Idealized slider bearing with a pivoted shoe, Step bearing, Infinitely long journal bearing, Infinitely short journal bearing.
Finite Bearings: Analytical and Numerical Solution, Cavitation and cavitation boundary condition.
Oil Flow and Thermal equilibrium: Circumferential flow and axial flow, Heat generation and heat balance, effective temperature of lubricant..
Bearing Design: Practical considerations in bearing design, Design of journal bearings
Squeeze Film bearings: Parallel surface bearing, step bearing, some situation under squeeze film lubrication
Hydrodynamic Instability: Mechanism of hydrodynamic Instability, Stiffness and damping coefficients
Externally pressurized Oil Bearings: Systems of hydrostatic lubrication, Circular step bearings
Gas-lubricated Bearings: Governing equations, Limiting solutions, Finite journal bearings, perturbation method.
Intorduction of Elastohydrodynamic: Lubrication, Surface Roughness, Effect on Hydrodynamic Bearings and Elastohydrodynamic Line contacts. Ball Bearings, Roller Bearings.
Friction of Metals: Laws of friction, Friction Theories, Frictional heating Effect of sliding speed on friction
Wear of Metals: Classification of wear, Mechanism of wear, Quantitative laws of wear

Texts/Reference:

1. B. C. Majumdar: Introduction to Tribology of Bearings: A. H. Wheeler & Co. Ltd., New Delhi,1999
3. A. Cameron and C. M. Mc Ettles: Basic Lubrication Theory: Wiley Eastern Ltd., New Delhi, 1987.

ME 1457 **MATERIAL HANDLING SYSTEMS** L T P C

(Departmental Elective-IV) 3 0 0 6
Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1202, ME 1304, ME 1308, ME 1433, ME 1475

Materials Handling and Storage: Introduction, Scope and Application of Material Handling, Function of material handling, Principles of Material Handling, Factors for Consideration in Material Handling System Design (Engineering factors, economics factor), Roles and Responsibilities of Manager/Supervisor/Foreman, Employees, Material Handling Department, General Requirements such as Personal Protective Equipment, Operating Requirements, Manual Material Handling, Maintenance Requirements
Facilities Design: Site Selection- Factors influencing the selection, rural and urban locations, Optimum decision on choice of site and analysis. Plant Layout- Types of production, types of layouts, advantages and disadvantages of layout, factor affecting layout, systematic layout planning
Material Handling Devices and Equipments: Vertical devices, Horizontal devices, Combination devices, Material Handling Equipment- Storage and handling equipment, Engineered systems, Industrial trucks, Bulk material handling, On-Rails Transfer Cart, Conveyors, Slings, Pallets, Cantilevered Crane Loading Platform, Cranes, Hoists & Auxiliary Equipment, Excavation Equipment
Material Handling System: Unit Load Principle, Unit load specification, Throughput, Response time, Cost, Space and cube utilization, Flexibility, Expandability
Material Handling Costs: Total Cost of Ownership, Initial purchase price, Operating expenses (fuel, disposables, etc.), Maintenance costs, Direct and indirect labour costs, Miscellaneous associated costs, Training, Insurance, Damage costs
Automated Material Handling: Introduction to Automated Guided Vehicles (AGVs), Components of AGVs, Types of AGVs, Guidance Systems for AGVs, Routing of AGVs, AGVs Control Systems, Robotic Applications in the Industry, Double-Gripper Robot in a Single-Machine Cell
Automation and Transfer Machine: Manufacturing system (Mass production, large scale production, small scale production), Conventional machine layout, Flow line system, Transfer machine (in-line transfer machine, rotary indexing table transfer machine, drum type transfer machine), constructional features of a transfer machine
Hazards & Hazard Controls and Safety: Definitions, Requirements, Potential hazards for workers, Storage hazards, Lifting Hazards and Safe Lifting Techniques, Safe Material Stacking, Safe Material Storage, Role of Ergonomics in Safe Materials Handling, Proper Use of Mechanical Material Handling Equipment, Application of Hazard Controls in Materials Handling and Storage, Safety and Health Principles, fire safety

Texts/Reference:

1. Courtney: Mechanical Behavior of Materials: McGraw-Hill, 2/e
2. Robert M Eastman: Materials Handling: Taylor & Francis publishing
3. K C Arora: Aspects of Materials Handling: Laxmi publishing.
4. Allegri: Materials Handling Principles and Practice: CBS publishing.
5. Sidhartha Ray: Introduction to Materials Handling: New Age International Publishing.
6. Richard Platts: Computing Needs for Automated Material Handling: Blackwell Publishing
7. John R Immer: Materials Handling: McGraw-Hill, publishing.
8. Matthew P Stephens, Fred E Meyers: Manufacturing Facilities Design and Material Handling: Prentice Hall Publishing, 4th Edition
9. K H E Kroemer, Karl Kroemer: Ergonomic Design for Material Handling Systems: CRC Press Publishin
10. Ray T K: Mechanical Handling Of Materials: Asian Books Pvt Ltd Publishing

ME 1461	**NON-CONVENTIONAL ENERGY**	L	T	P	C
	(Departmental Elective-V) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1201, ME 1206, ME 1207, ME 1302, ME 1402

Introduction: Various non-conventional energy resources, potential of renewable energy sources-global as well as Indian scenario.
Solar energy: Solar radiation, measurement of solar radiation, solar collector-flat plate and concentrating, collector efficiency, storage of solar energy, application of solar energy. Solar PVS
Wind energy: Principles of wind energy conversion, various types of wind machines.
Energy from bio-mass: Bio-mass conversion technologies, different types of bio gas plants, thermal gasification of boi-mass.
Geothermal energy: Geothermal resources, advantages and disadvantages over other non-conventional energy resources.,
Energy from the ocean: Ocean thermal energy conversion, open and closed cycle, hybrid cycle, introduction to tidal energy.
Hydrogen energy: Production, storage of hydrogen energy, application.
MHD power generation: Principle of MHD power generation, open and closed cycle systems.

Texts/Reference:

1. Khan B.H: Non-Conventional Energy Resources: McGraw-Hill, 2e
2. Sukhatme: Solar Energy : Principles of Thermal Collection and Storage: McGarw-Hill
3. Grag: Solar Energy: Fundamentalsand Applications: McGraw-Hill, 1st Revised Edition)
4. Kristoferson, LA & Bokalders, V Pergamon: Renewable energy Technologies
5. S Hasan Saeed & D.K. Sharma: Non-conventional Energy Resources: S.K. Kataria & Sons.

ME 1462	**VISCOUS FLUID FLOW**	L	T	P	C
	(Departmental Elective-V) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1207, ME 1302

Preliminary concepts, Conservation of mass, momentum and energy, Exact solutions of the viscous flow equation : Couette flows, Poiseuille flow through ducts, unsteady duct flows, Laminar boundary- layers integral analysis and similar solutions, Laminar free- shear flows : jet, wake and plume, Stability of laminar flows, Turbulent flow : fundamentals, Reynolds- averaged equations, velocity profile in wall-bounded flows, turbulent flow in pipes and channels, turbulent free- shear flows (jet, wake and plume), Turbulence modelling: zero, one, two equation models of turbulence, Numerical methods.

Texts/Reference:

1. Frank M White: Viscous Fluid Flow: McGraw Hill Publication, 3rd Ed

ME 1463	**ADVANCED REFRIGERATION SYSTEMS**	L	T	P	C
	(Departmental Elective-V)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME1206, ME 1421

Air-Craft Refrigeration System: Simple, Boot-strap, Regenerative and reduced ambient system, Actual cycles, Comparison and selection of air-craft refrigeration systems, Advantages and disadvantages.
Vapour Compression System: Actual cycle and its deviation from theoretical cycle, Compound compression systems, Multiple evaporator systems, Binary refrigeration systems, Production of dry ice, Thermodynamic analysis of these systems, practical applications.
Vapour Absorption System: Thermodynamic analysis of practical VAR system, Components, Single-stage and multi-stage Aqua- ammonia VAR system, Single-stage and multi-stage Lithium- Bromide-Water VAR systems, Three-fluid systems.
Non-Conventional Refrigeration System: Steam jet refrigeration system, Thermometric refrigeration system, Vortex- tube refrigeration system, Thermodynamic analysis of these systems, Merits and demerits of each system and their applications.
Refrigerants: Important refrigerants and their comparisons, Selection of refrigerants, Effect of environmental regulations on selection of refrigerants, Replacement, recycling of refrigerants.
Refrigerating Equipments: Compressors, Condensers, Expansion devices, Evaporators, Pipings, Line valves, Solenoid valves, Oil separators, Defrosting, Filters, Moisture indicators, purging 2 T.P. & controls.
Application of Refrigeration: Domestic, commercial, industrial, transport, and medical refrigeration, Preservation of food spoilage, Method of preservation, Cold- storage, Low temperature refrigeration.

Texts/Reference:

1. C.P. Arora: Refrigeration and Air conditioning
2. M. Prasad: Refrigeration and Air conditioning
3. Stocker & Jones: Refrigeration and Air conditioning
4. Jordan & Preister: Refrigeration and Air conditioning
5. P.N. Ananthanarayan: Refrigeration and Air conditioning
6. S.K. Kulshrestha: Refrigeration and Air conditioning
7. ASHRAE: ASHRAE Hand Book of Fundamentals
8. M. Prasad: Refrigeration and Air conditioning Data Book

ME 1464	**METAL CUTTING AND CUTTING TOOL DESIGN**	L	T	P	C
	(Departmental Elective-V)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME 1303, ME 1435,

Tool geometry, The essential features of metal cutting, the chip, technique for study of chip formation, chip shape, chip formation, the chip tool interface, chip flow under condition of seizure, Merchant circle diagram, stress on the shear plane, forces in flow zone, the shear plane angle and minimum energy theory, tool wear, types of tool wear, tool life criteria, work-piece interaction in machining tests, design of the tool shape on the basis of machining responses.

Texts/Reference:

1. A, Bhattacharyya: Metal cutting, Theory and practice: Central book publishers, 8/1, Chintamoni Das Calcutta
2. E.M. Trent: Metal Cutting: Butterworths
3. K.P. Sinha, S.C. Prasad: Theory of Metal Forming and Metal Cutting: Dhanpat Rai & Sons

ME 1465	**THEORY OF ELASTICITY AND PLASTICITY**	L	T	P	C
	(Departmental Elective-V)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME 1209, ME 1423

Theory of Elasticity: Concept of stress, stress tensors, equilibrium equations, octahedral stresses, concept of strain, strain tensors, generalized Hooke’s law, elastic strain energy.

Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.
Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain.
Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, simple problems.
Solution of axi-symmetric problems, stress concentration due to the presence of circular hole in plates.
Elementary problems of elasticity in 3-D, stretching of a prismatic bar by its own weight, torsion of circular and non-circular shafts, membrane analogy.
Theory of Plasticity
Introduction to ideally plastic solids: Ideally plastic solid, stress space and strain space, General nature of the yield locus, Yield surfaces of Tresca and Von Mises, plastic work, effective stress, effective strain, stress-strain relations (plastic flow), principle of normality, Prandtl-Reuss equations, Saint Venant – Von Mises equations, incremental and deformation theories, convexity of yield surface.
Theory of instability during plastic deformation.
Slip line field theory: introduction, basic equations for incompressible two dimensional flow, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line fields and hodographs.
Elastic-Perfect Plasticity: Introduction, elastic-plastic bending of beams, elastic-plastic torsion, thick-walled, pressurized cylinder, thin disc under pressure and rotating disc.

Texts/Reference:

1. Timoshenko & Goodier: Theory of Elasticity: McGraw Hill
2. Srinath L. S: Advanced Mechanics of Solids: Tata McGraw Hill
3. Popov EP: Introduction of Mechanics of Solids: PHI Pvt. Ltd, New Delhi
4. Chakraborty: Theory of Plasticity: Elsevier
5. Narayanasamy and Ponalagusamy: Theory of Engineering Plasticity: Ahuja Book Co. Pvt. Ltd
6. Rees D.W.A: Basic Engineering Plasticity: Elsevier

ME 1466	**AIR CONDITIONING SYSTEM DESIGN**	L	T	P	C
	(Departmental Elective-V)	3	0	0	6

Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- ME 1206, ME 1309, ME 1421, ME 1434

Psychrometric Processes: Review of psychrometric properties, Review of psychrometric processes.
Design Conditions: Choice of inside and outside design conditions, Parameters governing human comfort, Various comfort indices, Choice of supply design conditions, Clean spaces.
Design of Air Conditioning Apparatus: Design of cooling and dehumidifying coils, Air washer and Cooling Towers.
Load Analysis: Inside and outside design conditions, Load classification, Summer cooling loads, Solar terminology, Sun motion, Solar angles and their relationships, Calculation of solar radiation intensities, Solar heat gain through transparent bodies (e,g, glass), Transmission heat gain through building materials, Flywheel effect of building materials, Methods of calculating cooling load through building material, Loads due to human beings, Electric equipments and appliances, Infiltration and ventilation loads, Product loads, Miscellaneous loads such as duct heat gain, air leakage, pumps, Winter heat load- computation of loads, Cooling and heating load calculation methods.
Duct Design: Pressure drop calculation for various types of duct, Enlargements, Contractions, Branch tube- offs etc., Duct design methods – velocity deduction, equal friction and static regulation, Duct design procedure – dynamic loss coefficient method, equitable length method, Case studies on duct design.
Room Air Distribution: Air distribution terminology, air distribution system in rooms, supply and return grills, Case studies.
Air Conditioning Systems: Central and unitary air conditioning, Special features of residential, commercial and industrial air conditioning system, Year round air conditioning.
Equipments: Fans- types, characteristics, fan selection, Air filter and cleaner, Cooling tower, Condensers, Cooling coil and chemical dehumidifiers, Heaters, etc.
Instruments And Control: Temperature, Humidity, Air velocity measuring instruments, Thermostats, Humidistats, By pass and damper control, Dew point control, Noise control, Pneumatic control, etc.

Texts/Reference:

1. C.P. Arora: Refrigeration and Air conditioning
2. M. Prasad: Refrigeration and Air conditioning
3. Stocker & Jones: Refrigeration and Air conditioning
4. W. Jones: Air conditioning
5. P.N. Ananthanarayan: Refrigeration and Air conditioning
6. ASHRAE: ASHRAE Hand Book of Fundamentals

ME 1467	**RAPID PROTOTYPING**	L	T	P	C
	(Departmental Elective-V)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME 1307

Current Trends in Design and Manufacturing; the role of Rapid Prototyping and Rapid Tooling; General features and classifications of Generative Manufacturing Processes.
Two dimensional Layer by Layer Techniques: Stereo Lithography with photopolymerisation, liquid thermal polymerisation, solid foil polymerisation, selective laser sintering, selective powder binding, ballistic particle manufacturing, fused deposition modelling, shape melting, laminated object manufacturing, solid round curing, repeatative masking and deposition.
Three Dimensional Techniques for Rapid Prototyping: Beam Interference Solidification, Ballistic particle manufacturing, Holographic Interference Solidification.
Rapid Tooling: Techniques and procedures; Economics of Rapid Prototype and Rapid Tooling.

Texts/Reference:

1. Amitabha Ghosh: Rapid Prototyping - A Brief Introduction: East West Publishers
2. Frank W: Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development: Liou, Crc Press
3. Chua: Rapid Prototyping: Cambridge

ME 1481	**ENTREPRENEURSHIP DEVELOPMENT**	L	T	P	C
	(Open Elective-II)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- HS 1301, HS 1201, ME 1401

Evolvement of entrepreneurship from economic theory, Entrepreneurship and characteristics of entrepreneurs, Need for education on entrepreneurship, Competency and entrepreneurial competencies.
Creativity as a prerequisite to innovation, Innovation and entrepreneurship.
Self-assessment and window Self-reflecting self- awareness, Decision-making, Leadership, Motivation.
Concept of a planning paradigm for a new venture, Founstase growth model, Fundamentals of feasibility plan.
An introduction to patents, trademarks and spy rights, intellectual property right, Business opportunity identification, Need, scope and characteristics of a small scale business industry.
Marketing concept, Fundamentals of marketing, Distribution, Promotion, Pricing, Marketing strategy, Break-even analysis.
Total quality management, ISO standards, Management information system, Concept of Intellectual Property Right (IPR), Patent, Copyright, and Trademark.
Project planning and preliminary project report.

Texts/Reference:

1. Shankar: Entrepreneurship: Theory & Practice: McGraw-Hill
2. Hisrich: Entrepreneurship, by: McGraw-Hill, (Special Indian Edition), 6e
3. A.K. Singh: Entrepreneurship Development & Management: Laxmi Publication
4. David H. Holt: Entrepreneurship: - new venture creation: Prentice Hall Publication
5. Randolph & Ponker: Effective Project Planning & Management: Longman Higher Education

ME 1482	**HYDRAULIC MACHINES**	L	T	P	C
	(Open Elective-II)	3	0	0	6
	Eighth Semester				
	(Mechanical Engineering Branch)				

Pre-requisite- ME 1302, ME 1306

Principles of Hydraulic Machines: Impulse momentum equation, Impact of jet force on stationary flat plates and curved vanes, Force on moving fixed plate and curved vanes, Force on a series of moving flat plates and curved vanes, Euler`s equation of turbo- machines, Jet propulsion of ships.

Hydro- electric Developments: Water wheels- their types and working principles, Advantages and disadvantages of water wheels, Development of water turbines- their classifications and working principles, Advantages of water turbines, Hydro-electric plants- their classification, essential components and layouts, Advantages of hydro-electric plants, Pumped storage plants.
Impulse Turbines: Work done by impulse turbine, Power produced by impulse turbine, Efficiencies of an impulse turbine, Design of Pelton wheel turbine, Other impulse turbines.
Reaction Turbines: Differences between an impulse and a reaction turbine, Classification of reaction turbines, Power produced by a reaction turbine, Efficiencies of reaction turbine, Francis turbine, Kaplan turbine, Cavitation in reaction turbines, Draft tubes, Types of draft tubes, Efficiencies of draft tube, Other reaction turbines.
Governing of Turbines: Purpose of governing, Elements of governing system, Double regulation of turbines, Governing of impulse turbines, Governing of reaction turbines, Relief valve or pressure regulator.
Performance of Turbines: Characteristic of turbines, Unit power, Unit speed and unit discharge, Specific speed of a turbine- their significances, Selection of turbines based on Head of water and also based on specific speed, Characteristic curves of turbines.
Reciprocating Pumps: Pumps and its classification, Reciprocating pump- types, discharge and power required, Slip of the pump, Indicator diagram, Variation of pressure in the suction and delivery pipes on the indicator diagram, Maximum speed of the rotating crank with air vessels, Work done against friction with or without air vessels, Work saved against friction.
Centrifugal Pump: Advantages of centrifugal pump over reciprocating pump, Components of centrifugal pump, Working of a centrifugal pump, Working by the impeller, Heads of pumps, Losses and efficiencies, Multistage centrifugal pumps, Specific speed, Characteristic of a centrifugal pump, Priming, Minimum starting speed, Selection of pumps, operational difficulties in centrifugal pumps.
Miscellaneous Types of Pumps: Multi- cylinder pumps, Rotary pumps, Air lift pumps, Jet Pumps, Gear pumps.
Hydraulic Devices: Hydraulic accumulator, Hydraulic intensifier, Hydraulic press, Hydraulic coupling, Torque converter, Hydraulic brakes, Hydraulic cranes.

Texts/Reference:

1. Subramanya: Hydraulic Machines: McGraw-Hill
2. Jagdish Lal: Hydraulic Machines: Metropolitan Publication
3. Banga & Sharma: Hydraulic Machines: Khanna Publishers
4. R.K. Bansal: Fluid Mechanics & Hydraulic Machines: Laxmi Publication, 9th Ed
5. Vasandani: Hydraulic Machines Theory & Design: Khanna Publishers
6. S.S. Rattan: Fluid Machines: Khanna Publishers

ME 1483	**SOLAR ARCHITECTURE**	L	T	P	C
	(Open Elective-II)	3	0	0	6

Eighth Semester
(Mechanical Engineering Branch)

Pre-requisite- PH 1101, ME 1206, ME 1309

Thermal Comfort: General introduction, Parameters governing thermal comfort, Heat exchange of body with environment, Various comfort indices, Psychometric and psychometric chart, Comfort chart.
Climate & Solar Nomenclature: Climate change due to land, water, wind etc. Classification of climates, Sun motion, Solar angles and their relationships, Calculation of solar radiation intensities, Basic solar collectors, Shading devices.
Building with Solar Exposures: Various building forms and surface areas, Mutual shading of buildings, Building orientations with respect to sun, Efficiencies of building forms, Building penetration and its effect.
Passive Concepts & Components: Passive heating concepts- direct gain, indirect gain, sun space and indirect gain, Passive cooling concepts – minimization of beam radiation, Thick walls and roofs, Evaporative cooling, Radiative cooling, Cavity walls, Exploitation of wind, water earth for cooling, Sky therm, Vary therm wall, Earth shattered structure, Earth – air tunnels, Ventilation components.
Heat Transfer in Buildings: Modes of heat transfer- basic concepts, Surface coefficients, Overall thermal transmittance for various walls and roofs, Heat transfer due to ventilation/infiltration, Intermittent heat transfer.
Mathematical Modelling of Passive Concepts: Approximate methods- degree day method, steady state method, Correlation methods, Analytical methods- thermal circuit analysis, Finite difference approach, Response factor method, Periodic solution method.
Evaporative Cooling: Historical background, Basic principle and classification, Climate conditions, Direct types of E.C, Indirect type of E.C, 2- stage E.C, Earth cooling, Earth air tunnel systems.
Typical Design of Solar Passive Buildings: Case studies – For cold climate- the hedge type, ware house type, solarium and trembe wall type etc. For tropical climate – skytherm systems, For arid climate and for humid climate.

Texts/Reference:

1. M. S. Sodha, N. K. Bansal & A. Kumar: Solar Passive Building- Science & Design
2. N.K. Bansal & G. Hanser: Passive Building Design- A Hand Book of Natural Climate Control
3. C.P. Arora: Refrigeration and Air conditioning
4. ASHRAE: ASHRAE Hand Book of Fundamentals

ME 1484	**INTRODUCTION TO OPTIMUM DESIGN**	L	T	P	C
	(Open Elective-II) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1401, ME 1425, MA1101, MA1102, MA1201

Introduction: Need of optimum designs. Basic terminologies - design variables, objective functions, constraints, and variable bounds. Different types of optimization problems - single variable, multivariable, linear, non-linear, real/integer/discrete, single-objective, and multi-objective. Problem formulation. Fundamental concepts - global/absolute optimum point, local/relative optimum point, inflection point, and convex programming problems.
Single-variable unconstrained optimization: Graphical method. Exact method based on necessary condition. Direct search methods - bracketing the optimum point by exhaustive search method and bounding phase method, and refining the optimum point by interval halving method and golden section search method. Gradient-based methods - Newton-Raphson method, bisection method, and secant method.
Multi-variable unconstrained optimization: Fundamental concepts - gradient vector and Hessian matrix. Exact method based on necessary condition. Direct search methods - Simplex search method, Hooke-Jeeves pattern search method, and Powell's conjugate search method. Gradient-based methods - Cauchy's steepest decent method, Newton's method, and Marquardt's method.
Multi-variable constrained optimization: Linear programming problems - Graphical and Simplex methods. Non-linear programming problems - Kuhn-Tucker conditions and sensitivity analysis. Transformation methods - Penalty function method and method of multipliers (augmented Lagrangian method). Direct search methods - Variable elimination method, complex search method, and random search method. Gradient-based linearized methods - Taylor series expansion and unidirectional search, move limit method, Frank-Wolfe method, cutting plane method, and feasible direction method.
Integer programming Methods: Penalty function method, cutting plane method, and branch-and-bound method.

Texts/Reference:

1. Kalyanmoy Deb: Optimization for Engineering-Algorithms and Examples: Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Ashok D. Belegundu and Tirupathi R Chandrupatla: Optimization: Concepts and Applications in Engineering: Pearson Education, New Delhi.
3. Christos H. Papadimitriou and Kenneth Steiglitz: Combinatorial Optimization: Algorithms and Complexity: Prentice-Hall of India Pvt. Ltd., New Delhi.
4. Conley. W: Computer Optimization Techniques: Pntrecelli Book, 1980

ME 1485	**MEMS AND NANO-TECHNOLOGY**	L	T	P	C
	(Open Elective-II) Eighth Semester (Mechanical Engineering Branch)	3	0	0	6

Pre-requisite- ME 1204, ME 1307, EE 1101, EC 1101

Overview of MEMS and microsystems, microelectronics, microfabrication, miniaturization, typical MEMS and microsystems products.
Working principles of microsystems: microsensors, microactuation, MEMS with microactuators, microfluidics, microvalves, micropumps, micro-heat pipes.
Overview of materials for MEMS and microsystems: atomic structure of matter, ions and ionization, doping of semiconductors, diffusion process, electrochemistry.
Microsystem fabrication: photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, sputtering, etching.
Micromanufacturing: bulk micromanufacturing, surface micromanufacturing, LIGA process.
Assembly, packaging and testing of microsystems: overview of microassembly, microassembly processes, major technical problems of microassembly, microsystem packaging and its levels, essential packaging technologies, reliability and testing in MEMS packaging.

Nanotechnology: Introduction, introduction to physics of the solid state, properties of individual nano particles, carbon nano-tubes, and bulk nano structured materials.

Texts/Reference:

1. Mahalik: MEMS:, McGraw-Hill, 1/e
2. Tai-Ran Hsu: MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering: McGraw-Hill
3. Pradeep: A Textbook of Nanoscience and Nanotechnology: McGraw-Hill, 1/e
4. N. P. Mahalik: Micromanufacturing and Nanotechnology: Springer
5. Nadim Maluf, Kirt Williams: An Introduction to Microelectromechanical Systems Engineering: Artech House, Inc.
6. Mark Ratner, Danier Ratner: Nanotechnology: Pearson Education Inc.
7. Charles P. Poole Jr. & Frank J. Owens: Introduction to Nanotechnology: John Wiley & Sons, Inc.
8. Roger, Pennathur, Adams: Nanotechnology Understanding Small systems: CRC Press
9. Stephen Beeby, Graham Ensell, Michael Kraft, Neil White: MEMS Mechanical Sensors: Artech House, Inc.
10. Mohamed Gad-el-Hak: MEMS Introduction and Fundamentals: CRC Press

		L	T	P	C
ME 1486	**FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELPOMENT (FSIPD)**				
	(Open Elective)	3	0	0	6

(Mechanical Engineering Branch)

Unit 1: Fundamentals of Product Development:

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends (Demographic, Behavioral, Psychographic), Technical Trends (Technology, Applications, Tools, Methods), Economical Trends (Market, Economy, GDP, Income Levels, Spending Pattern, target cost, TCO), Environmental Trends (Environmental Regulations and Compliance), Political/Policy Trends (Regulations, Political Scenario, IP Trends and Company Policies); PESTLE Analysis.

*Introduction to Product Development Methodologies and Management***:** Overview of Products and Services (Consumer product, Industrial product, 'specialty' products etc.,); Types of Product Development (NPD/ Re-Engineering (Enhancements, Cost Improvements), Reverse Engineering/ Design Porting & Homologation); Overview of Product Development methodologies (Over the Wall / Waterfall/ V-Model/ Stage-Gate Process/ Spiral/Systems Engineering/ Agile); Product Life Cycle (S-Curve, Reverse Bath tub Curve); Product Development Planning and Management (Budgeting, Risk, Resources and Design Collaboration, Scheduling, Change Management, Product Cost Management).

Unit 2: Requirements and System Design

Requirement Engineering: Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management.

System Design & Modeling: Introduction to System Modeling; System Optimization; System Specification; Sub-System Design; Interface Design.

Unit 3: Design and Testing

Conceptualization: Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation - Concept Design, S/W Architecture, Hardware Schematics and simulation.

Detailed Design: Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing.

Prototyping: Types of Prototypes (Mockups, Engineering Assessment Prototype, Alpha, Beta, Gama); Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration, Testing, Certification and Documentation: Manufacturing/Purchase and Assembly of Systems; Integration of Mechanical, Embedded and S/W systems; Introduction to Product verification processes and stages – Industry specific (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific

(Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools).

Unit 4: Sustenance Engineering and End-of-Life (EoL) Support

Sustenance: Maintenance and Repair; Enhancements.

*Product EoL***:** Obsolescence Management; Configuration Management; EoL Disposal.

Unit 5: Business Dynamics – Engineering Services Industry

The Industry: Engineering Services Industry – overview; Product development in Industry versus Academia.

The IPD Essentials: Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and configuration management.

Text book: Student handbook, NASSCOM

Reference books:

a) Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development 4th edition", Irwin McGraw-Hill, 2008

b) Akao, Y.,ed. (1990). Quality Function Deployment, Productivity Press, Cambridge MA. Becker Associates Inc

c) Ullman, David G., "The Mechanical Design Process", Mc Graw-Hill, 4th edition, 2009

d) Kevin Otto, Kristin Wood, "Product design techniques in reverse engineering and new product development", Pearson, India, 2001

e) Sandborn P, Myers J. "Designing engineering systems for sustainability". In: Misra KB, editor. Handbook of performability engineering. London: Springer; 2008. P. 81-103.

ME 1487	**OFF-HIGHWAY VEHICLE ENGINEERING**	L	T	P	C
	(Open Elective)	2	0	2	6

(Mechanical Engineering Branch)

Prerequisite: ME1101, CE 1101, EE 1101, EC1101

Unit 1: Classification and Nomenclature of Construction and Earthmoving Equipment (Ref : ISO 6165)

Construction Equipment: Back hoe loaders, Dozers, Loaders, Excavators.
Road construction Equipment: Paver, Graders, Compactors.
Mining Equipment: Dump trucks, Blast drill.

Unit 2: Detailed Specification for different machines:
Specification for construction machines- back hoe loader, Excavator, Wheel loader.

Unit 3a: Description about system and part level Categorization, Functions, Selection and Sizing:

Transmission & Driveline: Types of transmission, Clutch, Gear box, Shifting Mechanism, Gear Reduction drives.
*Hydraulics & Pneumatics***:** Motor, pump, Valves, Coupling, actuator, cylinders, accumulator.
Structures: Cantilever & simply supported beam, Sheet metal & plate design.
Electronics, Electrical & Embedded: Sensors, Strain gages, Data acquisition device, signal processing device, GPS.
Cab & styling: FOPS (Falling Over Protection Systems), ROPS (Rolling Over Protection Systems), Ergonomics & safety, Trims, Operator interfaces.
Machine Integration: Aggregate integration, power train integration, Hydraulic, E&E.

Unit 4: Accessories of Construction machines:
Design & Details of Bucket, Blades, Arms, boom, dipper.

Unit 5: Regulations & Homologation requirements:
Indian Regulations and foreign homologation (US/EU) requirements for Construction Equipment.

Unit 6: Digital & Physical Design Validations Techniques:
Aggregate level Validation Techniques.
Equipment level Validations Techniques.

Case Study: Equipment Product development life cycle, Selection, Application, Commercial Feasibility Study:

VOC, Market study analysis, Business case preparation.
Back hoe loader for Indian market. Selection process for some applications.

Practical/Lab Sessions

Displays & Experiments

Unit 3b: Part and Functional level displays (may be in working models):

Heavy Engines & Transmission: Gear box sliding mesh, constant mesh, Synchromesh, Differential, Clutches
Hydraulics & Pneumatics: Types of Hydraulic motor and Pump, Valves, Cylinders.
Electronics & Electrical: Strain gauges.

Experiments/papers:

1. Single strain gauge circuit demonstration on a structure to measure strain.
2. Hydraulic circuit design using ISO symbols for Boom-bucket four bar linkage system
3. Pump-Motor selection with given torque, rpm and pressure system.
4. Teardown Benchmarking & VA/VE.

CH 1101 **CHEMISTRY** 3-1-0-8

All Branch- 1st/ 2nd Sem

Water and Its Treatment: Sources of water, impurities in water, hardness of water, its disadvantages, boiler scale and its prevention, caustic embrittlement, boiler corrosion, Industrial methods for treatment of water, domestic water treatment, B.O.D. and C.O.D.

Air Pollution: Classification and properties of air pollutants and their sources, Chemical behaviour in the earth atmosphere, photochemical smog, Effects of air pollution on human health and vegetation, Air pollution control: General methods.

Engineering Materials: Lime and Cement: Composition and manufacture of Lime and Portland cement, setting and hardening of cement, reinforced construction and decay of cements.

Fuel: Coal: source, classification, carbonization of coal, Analysis of coal, Determination of calorific value of coal by Bomb Calorimeter.

Petroleum: cracking of hydrocarbons, knocking, octane number and cetane number , synthetic petrol and petrochemicals, and bio-fuels.

Polymer and Plastics: Mechanism of polymerization, Molecular weight of polymers, Amorphous and crystalline polymers, Bio-polymers, degradation of polymers, commercially important thermoplastics and thermosetting plastics, Recycling of plastics, Conductivity and chemical resistance of polymers.

Lubricants: Introduction, functions and mechanisms of Lubricants, Classification of Lubricants, properties and testing of lubricating oils.

Surface/ Adsorption Science: Adsorption: chemisorption and physisorption, application of adsorption of gases on solids. Langmuir's adsorption isotherm, Freundlich's adsorption isotherm, BET theory of multi-layer adsorption (qualitative), adsorption chromatography, colloidal particles, surfactants, micelles, Enzyme catalysis, Criteria for choosing catalyst for industrial processes.

Corrosion Science and control: Introduction, mechanism of Corrosion, factors affecting Corrosion, passivity, protective measures against Corrosion: cathodic protection, prevention of Corrosion by material selection and design, use of protective coatings.

Nano-Chemistry: Synthesis, properties and applications, specialized techniques for the characterization of nano materials.

Books:

1. Engineering Chemistry – Jain, Jain (Dhanpat Rai)
2. Engineering Chemistry – Chawala S. (Dhanpat Rai)
3. Engineering Chemistry – Dara S. S. (S Chand)
4. Environmental Chemistry – Dey A. K. (New Age)
5. Physical Chemistry – Glasstone S. (Macmillan India)
6. Quantitative Chemical Analysis – Vogel A. I. (Longman)
7. Physical Chemistry – Moore W. (Prentice-Hall)
8. University Chemistry – Mahan B. H. (Narosa)
9. Physical Chemistry – Levine I. N. (McGraw Hill)
10. Analytical Chemistry – Kennedy J. H. (Harcourt-Brace Jovanovich)

CH 1111 **CHEMISTRY LABRATORY** 0-0-2-2

All Branch- 1st/ 2nd Sem

Prerequisites: None

To determine the strength of Iron (ll) solution volumetrically following the principles of Redox Titration.
To determine the strength of Iron (lll) solution volumetrically following the principles of Redox Titration.
To determine the strength of copper (ll) solution volumetrically using standard Hypo solution.
To determine the strength of copper (ll) solution volumetrically using standard $KMnO_4$ solution
Determination of total Hardness of water using Ethylene Diamine Tetraacetate (EDTA)
Determination of Temporary and Permanent Hardness of water
To determine the strength of Mg (ll) using Ethylene Diamine Tetraacetate (EDTA)
To determine the alkalinity of water titrimetrically using two indicators.
To determine the amount of Residual Chlorine using standard Hypo solution.
To determine the dissolved oxygen present in surface water and to identify the quality of water.

Books:

1 Vogel's Quantitative Inorganic Analysis (Longman)
2 Practical Chemistry (S Chand)
3 Qualitative analysis – Alexnder V.

HS 1101 **HUMANITIES** **L-T-P-C**

Communication Skill **3 0 0 6**

Semester-1

(i) Developing Writing skills:
  (a) Audience and Format
  (b) Composition and style
  (c) Structure
  (d) Grammatical error
  (e) Proofing
  (f) Key Points

(ii) Developing speaking skills:
  (a) Simulation of speaking environment to develop interaction through cultural and social exchange activities

(iii) Developing Reading skills:
  (a) Word attack skills
  (b) Comprehension skills
  (c) Fluency Skills
  (d) Critical reading skills

(iv) Developing listening skills
  (a) Listening as a challenging mental task
  (b) Staying active by asking mental questions
  (c) Understanding speech and thought

(v) Introduction to soft skills, phonetics; received pronunciation, transcription, grammar.

References

1. Nilanjana Gupta, English for All, 2nd edition, Macmillan India Ltd.;2000
2. Daniel Jones, The Pronunciation of English, Cambridge Press ;1956.
3. Peter Roach, English Phonetics and Phonology, Cambridge University Press; 2009.
4. Wren and Martin, Key to High School English Grammar and Composition, S. Chand, 1994.

HS 1201 **HUMANITIES** **L-T-P-C**

MANAGERIAL ECONOMICS (All Branch) **3 0 0 6**

Semester-4

Basic Concepts: Nature, Scope and Application of Managerial Economics.
Theory of Consumer behaviour and Demand Analysis: Demand Analysis, Elasticity of Demand, Demand Estimation and Forecasting, Supply, Equilibrium of a firm and industry.
Market Structure: Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly and Bi-lateral monopoly.
Cost Estimation: Theory of Cost, Analysis of Economies of Scale, Economies of Scope, Methods of Estimating Cost.
Theory of Production and Investment Decisions: Pricing and Profit Management, Decision Techniques, Project Appraisal Techniques and Social Cost Benefit Analysis
Introduction to Optimisation: Linear Programming
Macroeconomic Issues: National Income, inflation, Business cycle.
International Trade: Comparative advantage and H-O model, alternative theories of trade, Balance of Payment.

Reference

Mehta, P. L., Managerial Economics, Sultan Chand and Sons, New Delhi
Mote, V. L., P. Samuel and G. S. Gupta , Managerial Economics, McGraw-Hills, New Delhi
Craig, Petersen H. and Cris Lewis W., Managerial Economics, Prentice-Hall of India, New Delhi
Dwivedy, D. N. , Managerial Economics, Vikas Publishing House
Samuelson, P. A. and W. D. Nordhans , Economics, McGraw Hill, New York
Thuesen, G. J. and W. J. Fabrycky, Engineering Economics, Prentice Hall of India, New Delhi
Sullivan, W. G., J. A. Bontadelli and E. M. Wicks (2001): "Engineering Economics", 11th edition, Pearson Education Asia, New Delhi

HS 1301 **HUMANITIES** **L-T-P-C**

BUSINESS MANAGEMENT (All Branch) **3 0 0 6**

Semester-5

Introduction to Management

History of Management Thought: Classical, Behavioural & Modern Approaches

Basic Principles of Management: Concepts, Functions, objectives, scientific management
Fundamentals of Planning: Planning process, importance, concepts, MBO
Organisation Structure: Level of organisation, structure, authority, power, responsibility, centralisation & decentralisation
Human factors in managing organisation: Theories of motivation, leadership, communication process, conflict (nature, causes & its management), collective bargaining
Marketing Management: Brief introduction to various types of product, pricing, channel & promotional strategies
Social Responsibility of Business & Business Ethics
Financial Management: Source of finance & its management
Case study

Reference:
Prasad, L M. Principles and Practices of Management, S Chand and Co., New Delhi
Certo, Samuel C, Modern Management, Prentice Hall of India, New Delhi
Vanhom, J C. Fundamentals of Financial Management, Prentice Hall of India, New Delhi
Robins, S. P. & D. A. Decenzo: Personal/Human Resource Management, Prentice Hall of India, New Delhi
Schermerhorn, John R . Introduction to Management (10^{th} Ed.), Wiley India (P) Ltd., New Delhi
Bhat Anil, Kumar Arya; Management Principles, Processes, And Practices, Oxford University Press, New Delhi
Schermerhorn, John R; Introduction to Management; Wiley India Pvt. Ltd., New Delhi

HS 1401	HUMANITIES (Open Elective) BUSINESS ENVIRONMENT (All Branch) Semester-8	L-T-P-C 3 0 0 6

National Business Environment
Objectives and achievements of Five Year Plans--Industrial Policy Resolutions--State-led Development Vs Market-led Development— the Hindu Rate of Growth--Economic Reforms: structural, financial, banking, manufacturing and service.
Global Business Environment
Globalization—meaning, trends and features. Globalization and industrial relocation—role of technology in the process of globalization—factor mobility and globalization—Rybczynski theorem—Stolper-Samuelson theorem—Impact of globalization on labour market.
FDI and Economic Development
Distinction between FDI and FPI—Theories of FDI—FDI, technology transfer and economic development—trends of FDI in India—inward and outward—Distribution of FDI across different sectors and regions—Types of FDI—Market Seeking, Resource Seeking, Efficiency Seeking, Asset Seeking—Linkages between FDI and Economic Growth.
Institutions and business environment
WTO : Role of WTO in removing protective trade environment—quantification of tariff—creation of "level playing field".
IMF: Role of IMF in stabilization of national economies.
WB: Role of World Bank in developing the less developed countries
WIPRO: Role of WIPRO in protecting intellectual property rights

References:
Websites of Indian Business Regulators, Planning Commission, MoF, MoI, MoC, NCAER.
World bank website, IMF websites, WTO website, WIPRO website, EU website, NAFTA website, ASEAN website, APEC website, SAARC website, OECD website, NAM website, UNDP website.
Acharya, S, 2006, *Essays on Macroeconomic Policy,* OUP, New Delhi
Blomstrom, M, Kokko, A, and Mario, Z, 2000, *Foreign Direct Investment: Firm and Host Country Strategies,* Mcmillan
De Mello, L.R., 1999, "Foreign Direct Investment-Led Growth: Evidences from Time Series and Panel Data, Oxford Economic Papers 51.
Jones, Ronald W., 2000, Globalization and the Theory of Input Trade, MIT Press, Cambridge
World Investment Reports, UNCTAD, UN, Geneva

MA - 1101 **Mathematics-I** **3 - 1- 0 - 8**

Semester-1

Infinite Series:

Definition of Sequence & Infinite series, Convergence & Divergence of real Sequence & Infinite Series, Tests of Convergence of positive term infinite series: Comparison Test, D' Alembert's Ratio Test, Raabe's Test, Cauchy's root Test, Integral Test, Alternating Series , Leibnitz's Test.

Differential & Integral Calculus:

Successive differentiation, Leibnitz's theorem, Rolle's Theorem, Lagrange's Mean value theorem, Taylor's & Maclaurin's theorems with Lagrange's form of remainder for a function of one variable, Curvature: Radius & centre of curvature, Asymptotes and curve tracing, Partial differentiation, Euler's theorem, Jacobian, Gradient, Divergence, Curl and Directional derivatives.
Beta function & Gamma function.

Differential Equation:

Exact differential equation of first order, Integrating factors, linear differential equations, Second & higher order linear differential equations with constant coefficients, Homogeneous linear differential equation, Method of undetermined coefficients, Method of variation of parameters.
Series Solutions of ODE: Method of Frobenius, Legendre's equation and Bessel's equation, Bessel's function & Legendre's Polynomial.

Laplace Transform:

Laplace and inverse Laplace transforms & their properties, Convolution Theorem, Solution of ODE by Laplace transform method.

Text/Reference:

1. Kreyszig,Advanced Engineering Mathematics,Wiley India Pvt. Ltd., 9th ed, 2012.
2. S.G.Deo, V. Lakshmikantham and V. Raghavendra,Text Book of Ordinary DifferentialEquations,Tata McGraw-Hill,1977.
3. B.C. Das & B.N.Mukherjee ,Differential Calculus, U.N. Dhur & Sons Pvt. Ltd, 51th ed, 2009
4. B.C. Das & B.N.Mukherjee , Integral Calculus, U.N. Dhur & Sons Pvt. Ltd, 54th ed, 2008.
5. B.S. Grewal,Elementary Engineering Mathematics, Khanna Publisher, 2011.

MA -1102 **Mathematics-II** **3 - 1- 0 – 8**

Semester-2

Linear Algebra :

Vector spaces with special reference to R^n and its subspaces, Linear dependence and independence of vectors; Rank and nullity of a matrix , Elementary transformations, Consistency of a System of linear equations & their solutions by Direct Methods: Matrix inversion method, Gaussian elimination method & Gauss-Jordan method ; Solution by Iterative Methods: Jacobi's method & Gauss-Seidal method ; Eigen values & eigen vectors. Caley-Hamilton's theorem & its applications, Diagonalization by similarity transformations, Linear transformations, Band matrix and its applications.

Multiple Integrals:

Double and triple integrals with applications to volume and surface area, Applications of Green's, Stokes's and Gauss's theorems.

Complex Analysis:

Function of a complex variable, Analytic function , harmonic function, Cauchy-Reimann equations, Complex line integral , Cauchy-Goursat theorem, Cauchy's Integral formula, Morera's theorem, Liouville's theorem, Singularities and residues, Cauchy's Residue theorem and its application to evaluate real integrals.

Numerical Analysis:

Finite difference and Newton's interpolation formulae, Solution of algebraic and transcendental equations by Iteration method and Newton-Raphson Method; Solution of ODE by Picarcl's method, Taylor series method and Runge-Kutta method (Fourth order).

Text/Reference:

1. Kreyszig,	Advanced Engineering Mathematics,	Wiley India Pvt. Ltd., 9th ed, 2012.
1. Frank Ayres,	Schaum's Outline of Matrices,	Mc Graw Hill, 1975.
3. M.R.Spiegel,	Schaum's Outline of Laplace Transforms,	Mc Graw Hill, 1965
4. B.S.Grewal,	Higher Engineering Mathematics,	Khanna Publisher,2011
5. L. V. Ahlfors,	Complex Analysis,	MacGraw-Hill, 1977.
6 D. Sarason,	Complex Function Theory,	Hindustan Book Agency, 1994

MA-1201 **Mathematics-III** **3 -1- 0 –8**

Semester-3

Partial Differential Equation:

Formation of partial differential equations (PDE), Solution of PDE by direct integration, Lagrange's linear equation, Non-linear PDE of first order, Charpit's Method, Homogeneous and Non-homogeneous linear equations with constant coefficients, Boundary and initial value problems (Dirichlet and Neumann type): Heat, Wave & Laplace's equations (Two dimensional Polar & Cartesian Co-ordinates), Solution by the method of separation of variables

Fourier Transforms:

Introduction to Fourier series, Fourier sine and cosine transforms, Solution of PDE by Fourier transform.

Probability & Statistics:

Introduction to probability. Additive & multiplicative Laws of probability conditional probability, independent events. Baye's theorem; Probability density function, distribution function, Binomial, Poisson & Normal distributions, Mathematical expectation of random variables, Moment generating function, Chebyshev's inequality, Central limit theorem.

Curve fitting: Fitting of straight lines & parabolas by the method of least squares; Correlation & Regression analysis ; coefficient of correlation, coefficient of regression, lines of regression.

Two-Dimensional Random Variables: Joint, marginal and conditional probability distributions, Expectation of two dimensional random variables.

Text/Reference:

1. Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd., 9th ed, 2012
2. I.N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, 1988
3. L. C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol. 19, AMS, 1999
4. J. Ravichandran, Probability and Statistics for Engineers, Wiley India Pvt. Ltd, 2010.
5. B.S.Grewal, Higher Engineering Mathematics, Khanna Publisher,

MA-1251 **Mathematics-IV (Introduction to Stochastic Process)** **3 -1-0-8**

Semester-4

Branch: CSE

Description and definition, Markov chains with finite and countably infinite state spaces, Classification of states, irreducibility, ergodicity, Basic limit theorems, Markov processes with discrete and continuous state spaces, Poisson process, pure birth process, birth and death process, Brownian motion.

Applications to queuing models and reliability theory.Basic theory and applications of renewal process, stationary process, Branching process, Markov Renewal and semi-Markov process, regenerative process.

Estimation: concept of sampling, sampling distributions & standard errors, confidence interval, estimation of mean & variance, maximum likely-hood method of estimation for parameters of distribution,

Testing of hypothesis:Confidence interval, level of confidence, Testing of Hypothesis (Normal),

Small Sample Tests: t-Test , F-Test &χ^2 - Test .

Texts/Reference:

1. An Introduction to Probability Theory and its Applications (Vol. I&II)- Feller, W. ,John Wiley
2.Probability, Random Variables & Stochastic process – Papoulis ,McGraw-Hill
3. Probability & Stochastic Process for Engineers – Helstrom, C.W. ,McMillon
4. Probability & Random Process for Electrical Engineers – Leon-Garcia A. ,Addison Wisley
5.The Theory of Stochastic Process – Cox,D.R. and Miller H.D. ,Chapman & Hall
6. Stochastic Models in Queuing Theory – Medhi J. ,Academic Press
7. Probability, Stochastic Process, and Queuing Theory : The Mathematics of Computer Performance Modelling- Nelson R. Springer
8.Stochastic Process – Ross, Sheldon M., Wiley, 1995.
9. Mathematical Statistics with Applications – Freund, John E, Pearson, 2004.
10. Probability and Statistics for Engineers, Ravichandran, Wiley India, 2010.

MA -1351 **Mathematics-V (Numerical Methods)** **3-1-0-8**

Semester-5

Branch: CSE

Curve Fitting:

Method of Least Square (Fitting of a straight line, fitting of a second degree parabola, fitting of an exponential curve).Solution of

Algebraic and Transcendental Equations:

Review of solution of algebraic and transcendental equations by Iteration method and Newton-Raphson Method,

Bisection method, Regula-Falsi method (with their geometrical concepts).

Solution of a system of linear equations:
Direct methods (Gauss elimination method, Gauss Jordan method, LU decomposition methods), Iterative methods (Gauss Jacobi method, Gauss Seidel method).
Interpolation and approximation:
Review of Newton's forward & backward interpolation formulae,Lagrange's interpolation formula, divided differences, Newton's divided difference formula.

Numerical differentiation and integration:
Derivatives using Newton's forward, backward difference formula and Newton's divided difference formula, Numerical integration: Newton-Cote's quadrature formula, Tapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule, Weddle's rule. Twoandthree points Gaussian quadrature formulae, Double integrals using Trapezoidal rule and Simpson's rules.
Initial value problems and Boundary value problems in ODE:
Single step methods –Solution of ODE by Euler and Modified Euler method, Runge-Kutta method (Fourth order) for solving first and second order differential equations, Shooting method for second order differential equations.
Multistep methods – Milne's and Adam's predictor and corrector methods.

Texts/Reference:

1. Applied Numerical Analysis – Gerald C.F. and Wheatley, P. O., Addison Wesley,7^{th}ed, 2003.
2. Numerical Analysis - Burden R.L. and Faires, J.D. ,Thompson, 9^{th}ed, 2001.
3. Numerical Mathematical Analysis – Scarborough J.B. ,Oxford, 1950
4. Elementary Numerical Analysis: An Algorithmic Approach– Conte S.D. and Boor C.D. 3^{rd}ed 1981,McGraw-Hill.
5. Applied Numerical Methods – Carnahan B., Luther, H.A. and Wilkes, J.O. 1969,John Wiley.
6. Numerical Methods for Engineers-Chapra, S.C. and Carnale, R.P. 2002), McGraw-Hill,Boston.
7. Introductory Methods of Numerical Analysis – Shastri, S.S., PHI New Delhi, 4^{th}ed, 2005.
8. Computer Based Numerical Methods and Statistical Techniques –P.K.De, CBS Publishers, New Delhi, 2006.
9. Numerical Analysis – Kendall Atkinson, Wiley Publishing House.

MA 1441 **Operation Research** **3 - 0 - 0 - 6**
(Open Elective)
Semester-8

Introduction to Operation Research (O.R):
Definition of O.R. Principles of Modeling , Features and Phases of O.R. Areas of application of OR.

Linear Programming:
Introduction. Formulation of Linear Programming Problems (LPP),.Convex sets & their properties. Fundamental Theorem of LPP. Graphical solution of LPP, Solution of LPP by Simplex Method ,Two Phase method & Big-M method. Duality and its importance.

Transportation Problem(T.P):
Introduction.Mathematical formulation. Balanced & Unbalanced T. P. Rules to find initial Basic feasible Solution (BFS) of a T.P: North West Corner Rule, Row-Minima method, matrix minima method & Vogel's approximation method, Solution algorithm of TP by MODI method. Resolution of degeneracy of a TP.

Assignment Problem(A.P):
Introduction , Mathematical Formulation. Reduction theorem.Balanced and Unbalanced A.P. Hungarian Algorithm for solving A.P. Restricted AP.

Sequencing Problems:
Introduction. Solution of Sequencing problems. Processing n jobs through 2 machines, 2 jobs through m machines (Graphical method), Processing n jobs through m machines.

Integer Programming Problems (I.P.P):
Introduction.Pure and mixed integer programming problems.Gomori's Cutting Plane method for solving I.P.P.

Texts/Reference:

1. F.S. Hiller and G. J. Lieberman,	Introduction to Operations Research	McGraw-Hill
2. G. Hadley	Linear Programming	Narosa Publishing House
3. KantiSwarup	Operations Research	Sultan Chand & Sons
4. J.K. Sharma	Operations Research	MacMillan India Ltd
5. Hamady A Taha	Operations Research	Prentice Hall of India
6. P.M.Karak	Linear Programming	New Central Book Agency

MA- 1442 **Mathematical Modelling** **3-0-0-6**

(Open Elective)

Semester-8

Mathematical modelling: Simple situations requiring mathematical modelling, Techniques and classification of mathematical modelling (deterministic and stochastic models), Characteristics and limitations of mathematical models, Some simple illustrations.

Mathematical modelling through ODE: Different types of simple ODE models, Linear and non-linear growth and decay models of population, Non Linear Growth and Decay Models, Compartmental Models.

Mathematical modelling through difference equations: Models used in economics , Finance , Population dynamics, Genetics.

Mathematical modelling through partial differential equations: Models arising in heat conduction, wave propagation, Blood flow, Traffic flow in a high way.

Mathematical modelling through LPP and NLPP: Simple models through LPP and NLPP.

Mathematical models in engineering: Models of elasticity, Models of electrical circuits- Electrical networks and Kirchoff's laws, Models in surveying technology, Models in thermodynamics

Texts/Reference:

1. J.N.Kapoor, Mathematical Modelling, New Age International (P) Ltd, New Delhi, 1988..
2. J.Caldwell and Y.M.Ram, Mathematical Modelling, Concepts and Case Studies, Springer, 1999.
3. A. A. Samarskii and A.P.Mikhailov, Principles of Mathematical Modelling, CRC Press,2001.
4. Edward A. Bender, An Introduction to Mathematical Modelling, John Wiley and Sons.
5. E.A. Bender, An introduction to mathematical modelling. Wiley, New York, 1978.
6. J.France and J.H.M.Thornley,Mathematical models in agriculture, Betterworths, London, 1984.
7. Mark M. Meerschaert, Mathematical Modeling, Academic Press, 4thed, 2013.
8. J.Berry and K.Houston, Mathematical Modelling, Gulf Professional Publishing, 1995.

MA- 1443 **Modern Algebra** **3-0-0-6**

(Open Elective)

Semester-8

Posets& Lattices:

Partial order relations, Po-set, Lattices & Boolean algebra.

Groups:

Groups, Subgroups, Normal subgroups, Permutation group, Lagrange's Theorem, Cyclic groups, Quotient group, Homomorphism of groups, First three isomorphism theorems, Inner Automorphism, Normalizer/Centralizer of an element, Centre of a group,Conjugacy relation, Class equation, Sylow's Theorems, Subnormal & Normal series, Solvable group, Commutators, Nilpotent groups, Free groups.

Rings:

Ring, Integral domain, Field, Ideals & Quotient rings, Homomorphism of Rings, Maximal Ideal, Minimal Ideal, Prime Ideal, Principal Ideal, Principal Ideal Ring / Domain (PIR / PID), Euclidean Domain, Polynomial Rings, Field of quotient of an integral domain, Field extensions.

1. Modern Algebra Surjitsingh&ZameeruddinVikas Publishing House
2. Modern Algebra I.N. Herstein New age International
3. Modern Algebra Khanna&BhamriVikas Publishing House

MA- 1444 **Functional Analysis** **3-0-0-6**

(Open Elective)

Semester-8

Metric Space :

Definition and Examples of metric space . Open Sphere, Open Set & Closed Set. Convergence of sequences, Cauchy sequence, Complete Metric Spaces, Sequentially Compact Metric Space, Continuous mappings.

Topological Space :

Definition and examples, Trivial and non-trivial topology, Cofinite topology, Usual Topology with special reference to R. Continuity and homeomorphism.

Functional Analysis :

Linear space, subspace, basis, dimension, normed linear space, Banach space, continuous linear transformation, Conjugate space, Inner product spaces, Hillbest space, Orthogenality, orthonormal sets, Cauchy's Schwartz's inequality, Bessel's in equality. Linear operators, Self adjoint operator, normal and unitary operators, Projections, Spectrum of an operator.The spectral theorem.

Reference Books:

1. Introduction to Topology and Modern Analysis	Simmon G.F.	Tata McGraw Hill
2. Functional Analysis	B.K. Lahiri	World Press Pvt. Ltd.
3. General Topology	Lipschutz	Schaum Outline Series, McGraw Hill Book Company.

PH 1101 **PHYSICS** **L-T-P-C**
3-1-0-8

All Branch- 1st/ 2nd Sem
Prerequisites: None

Optics: Diffraction, Distinction between Fresnel and Fraunhofer diffraction; Fraunhofer diffraction-Single slit diffraction, Rayleigh's criteria of resolution and resolving power of telescope

Waves and Oscillation: Overview of vibrations with emphasis on damped and forced oscillations, resonance, coupled oscillations, normal modes.

Electromagnetic Waves: Basic ideas on Gradient of scalar field, divergence of a vector field, curl of a vector field. Maxwell's equations, displacement current, electromagnetic (EM) waves, Pointing's theorem, plane. EM wave in free space & in conducting media.

Quantum Mechanics: Failure of Classical physics, qualitative review of relevant experiments such as photo-electric effect Davisson & German expt. de Broglie matter waves, uncertainty principle, classical wave equation and Schrödinger equation (time dependent & time independent), physical meaning of wave function, probability interpretation, particle on a 1D infinite potential well, potential barrier and quantum tunneling.

Solid state Physics: Crystalline and amorphous state of matter, crystal bonding, crystal structure, unit cell-Primitive cell, Bravais Lattice, crystal planes, Miller indices, inter-planer distances.

Band theory of solids**:** Classification of materials based on band theory of solid (qualitative description), semiconductor (Intrinsic & Extrinsic), Fermi level, Density of states, electron & hole concentration at thermal equilibrium.

Advanced Materials: Fundamentals of mesoscopic physics and nano technology: nanomaterials (one, two and three dimensional) – Physical properties and applications.

PH 1111 **PHYSICS LABRATORY** **L-T-P-C**
0-0-2-2

All Branch- 1st/ 2nd Sem
Prerequisites: None

1. To compare two low resistances by drop of potential method using a meter bridge.

2. To calibrate an ammeter with the help of a potentiometer.

3. Study of the twist in the thin rod by statistical method by using Barton's horizontal apparatus and thus to determine the modulus of rigidity.

4. Study of bending of a beam supported at its end and loaded at its middle and thus to determine Young's modulus of the material of the beam.

5. Determination of the Refractive index of the material of a given prism using a Spectrometer.

6. Determination of the Wavelength of Sodium light by using a Plane transmission Grating.

7. To study of the transverse wave over the sonometer wire and hence to determine its velocity.

8. To study the magnetic field produced by a current carrying solenoid using a search coil and to find the value of μ_o with distance.

9. To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph.

REGULATIONS FOR

THE DEGREE OF

BACHELOR OF TECHNOLOGY
(B. Tech)

(EFFECTIVE FROM ACADEMIC SESSION 2012-13)

NATIONAL INSTITUTE OF TECHNOLOGY SILCHR
Silchar , Assam 788010

"Purity, patience, and perseverance are the three essentials to success"

Swami Vivekananda

National Institute of Technology Silchar

Message from the Director

I feel happy that a new rules and regulations for the B. Tech programme in NIT Silchar have come into existence. With the change in education policy, there is a sea change in the education system, so that the old rules were not fitting to the need of students. An effort has been made to encourage the learning habit of a student and to promote an overall development of the education across the Institute. This book will give a clear picture of the education policy of this Institute and will help students to follow the desired path. I hope most of the doubts and conflicts will be solved instantly through this book. I request all the teachers and students to please go through the book carefully and find out a solution to your problem.

The rules have given an ample scope for academically weak students to build up their career without compromising the quality of education. A continuous evaluation process has been maintained so that all the students concentrate more on studies. The teachers will also get enough time to promote research and consultancy activities during working hours.

Let us all work together with more dedication and sincerity to lift this Institute to top five.

With my very best wishes,

N. V. Deshpande
Director

Contents

QUOTES

The first problem for all of us, men and women, is not to learn, but to unlearn.
Gloria Steinem

The roots of education are bitter, but the fruit is sweet.
Aristotle

Success is walking from failure to failure with no loss of enthusiasm
Winston Churchill

Failure defeats losers, failure inspires winners
Robert T. Kiyosaki

Live as if you were to die tomorrow. Learn as if you were to live forever
Mahatma Gandhi

Education is the most powerful weapon which you can use to change the world
Nelson Mandela

LIST OF FORMS

ORDINANCE

0.1 The provisions contained in these regulations govern the conditions for imparting courses of instruction, conducting examinations and evaluation of students' performance leading to the Degree of Bachelor of Technology (B.Tech.)

These regulations are effective for the batches of students admitted in the Academic Session 2012 – 13 onwards.

0.2 Disciplines: The disciplines in which the courses of study are available and degrees will be offered are:

(i) Civil Engineering (CE)

(ii) Mechanical Engineering (ME)

(iii) Electrical Engineering (EE)

(iv) Electronics & Communication Engineering (ECE)

(v) Computer Science & Engineering (CSE)

(vi) Electronics & Instrumentation Engineering (EI)

New disciplines may be added in future with approval of the competent authority.

0.3 The provisions of these regulations shall also be applicable to any new discipline(s) that is (are) introduced from time to time and added to the list in Sec. 0.2.

0.4 A student becomes eligible for the award of the B.Tech. degree after fulfilling all the academic requirements and Extra Academic Activities (EAA) as prescribed in these regulations.

0.5 Supplementary regulations, whenever necessary, may be framed and implemented by the Senate from time to time.

0.6 Notwithstanding all that have been stated in these regulations, the Senate has the power to modify any of the clauses from time-to-time.

REGULATIONS

1 Admission

1.1 Admission to all courses will be made in the first semester through a National Level admission test. Detailed rules of such test shall be available in the "Information Brochure" published by the examination conducting authority assigned by the Ministry of Human Resources Development, Government of India.

1.2 The selected candidates have to take admission to the Institute on the dates specified by the counseling authority. Under special circumstances, e.g. for foreign students nominated by the Government of India or students with serious medical illness, the Senate may condone delay for admission.

1.3 If, at any time after admission, it is found that a candidate has not fulfilled all the requirements stipulated in the offer of admission, the Dean (Academic) may revoke the admission of the candidate and report the matter to the Senate.

1.4 In addition to the students admitted as per clause 1.1, a specified number of foreign nationals selected
under the policy laid down by the Government of India may be admitted directly to the first semester of any of the courses covered by these regulations.

1.5 The Institute reserves the right to cancel the admission of any student and ask him/her to discontinue his/her studies at any stage of his/her studies on grounds of unsatisfactory academic performance, irregular attendance in classes or indiscipline.

1.6 At the time of admission, the student is required to produce in original and provide photocopies of the following documents:

(a) A valid certificate for proof of age (Birth certificate or Board certificate as laid down in the information brochure of the admission)

(b) Pass certificate of the qualifying examination

(c) 10+2 mark/grade sheet

(d) College/School leaving certificate

(e) Caste/category certificates

(f) Migration certificate, if applicable.

In addition to these documents, he/she has to submit two recent passport size color photographs along with a filled-in application (Form AC/104) for enrolment in the course.

1.7 A provisional admission may be given if any of the certificates is not produced. However, it has to be submitted within the dates specified by the counseling authorities, or any other date to be fixed by the Senate, failing which admission will be cancelled and fees deposited will be forfeited.

1.8 The number of seats in each branch of the undergraduate programme for which admission is to be made will be decided by the BOG on recommendation of the Senate of the Institute. Seats are reserved for candidates belonging to Other Backward Classes, Scheduled Castes, Scheduled Tribes, Physically challenged candidates, and children of defence personnel who died fighting for the country as per the

decision of Government of India/Council of NITs from time to time.

2 ACADEMIC CALENDER

2.1 Each academic session is divided into two semesters of approximately 16 weeks duration so that a minimum of 40 lecture classes are made available for each course. The sessions are: odd semester (July–December) and even semester (January–June).

2.2 The schedule of academic activities approved by the Senate for a session including dates of registration, mid-semester, and end-semester examinations, inter-semester breaks etc. shall be laid down in the Academic Calendar for the session.

2.3 The academic calendar will also reflect the scheduled vacations. Further, the Director, in the capacity of Chairman Senate, may announce suspension of classes when the situation so demands. Such suspended classes may or may not be compensated on a weekend/holiday or by other means as announced on case-to-case basis.

3 Faculty Advisor and Student Counselor

3.1 Faculty Advisor

To help the students in planning their courses of study and getting general advice on the academic programme, the Dean (Academic) shall assign Faculty Advisors during the first year primarily from Science and Humanities departments. From second year onwards, the concerned department shall assign Faculty Advisor(s) from the department. The Faculty Advisors will monitor academic progress, approve selection of electives and registrations of other courses etc. of the concerned students.

3.2 Student Counselor

Soon after admission of new batch of students, Dean (Academic) office will nominate students' counselors for a group of 20-25 students. The students shall maintain a regular liaison with concerned counselor, by meeting at least once in a month and report his/her progress/grievances/difficulties etc. The counselors will render meaningful counseling (both emotional and psychological), liaison with course teachers in matters of attendance and performance, recommend leave of absence of the students to higher authorities, communicate with their parents etc. Their role is critical for personality development, career planning, and welfare of the group particularly for academically weak or de-motivated students, who need to be guided out of their academic or social situations. Office of the Dean (Academic) will provide all sorts of assistance to the counselors for academic development of the students. Counselors will continue to act till all the students of the concerned group graduate or leave the Institute. The student counselors are to report to the Dean (Academic) for any unusual observation among the students of his/her group.

4 RESIDENCE

4.1 Institute is by and large residential and all students shall be generally required to reside in, and be a member of the hostels to which they are assigned by Dean (Students Welfare) (Dean (SW)). Under special circumstances, the Director/Dean (SW) may permit a student to reside with his/her parent/guardian in the Institute campus or within a reasonable distance from the Institute. However, such permission may be withdrawn at the discretion of the Institute authority, at any time considered appropriate, without assigning any reason thereof.

4.2 No married accommodation shall be provided to any student of the UG courses.

4.3 All students must abide by the rules and regulations of the hostel as may be framed from time to time by appropriate body/authority and approved by the Senate.

5 COURSE STRUCTURE

5.1 The terms course and subject are used synonymously in these regulations. The duration of the course leading to B.Tech. degree will ordinarily be four years. A student may, however, opt for the slow pace programme if he/she does not feel comfortable with the work load. Under certain cases, e.g., poor grades, he/she is required to proceed in slow pace to minimize the time required to complete the programme. The maximum duration of B.Tech. Programme is six years.

5.2 In order to qualify for a B.Tech degree of the Institute, a student is required to complete the credit requirement as prescribed in the curriculum for a particular programme. The credit requirements for a programme will be 320 credits distributed over all the semesters and some EAA.

5.3 Teaching of the courses shall be reckoned in terms of credits or credit points; Credits are assigned to the courses based on the following general pattern:

- Two credits for each lecture period
- Two credits for each tutorial period

- One credit for each Practical or Project session of one hour.

5.4 The total academic course package for a department consists of the following components:

(a) Institutional core subjects
(b) Departmental core subjects, including projects
(c) Departmental elective subjects
(d) Institutional elective subjects

5.5 Normally, subjects based on engineering or scientific principles or on thought provoking information, where it is possible to conduct a closed book examination will be taught as theory courses, whereas those based on applications and practice (conceptual, computational or experimental) will be covered under Practical courses. In any case the nature of the subject (theory/practical) shall be decided by DUPC.

5.6 Normally, every course identified by a single course identifier, shall be taught by a single teacher (course coordinator), who may be assisted by adjunct faculty, teaching assistants, postgraduate and research scholars, and by other faculty members. The administrative responsibility including decision on contents of instruction and examination as well as submission of grades shall rest solely on the course coordinator.

However, larger classes may be divided into several sections, each section being taught by one teacher (course coordinator). Of course, a single teacher may also teach more than one section for the same course. Teachers of all sections of a subject will form a coordination committee for the course which will collectively take all decisions on the course. The Head of the Department will choose one of the members as the coordinator of the committee.

5.7 The course work requirements may be broadly divided into following four main groups of subjects:

(a) Humanities and Social Sciences
(b) Basic Sciences and Mathematics
(c) Engineering Sciences and Practice
(d) Professional subjects

Final and pre-final year UG students may take PG (M.Tech., M.Sc., MBA) courses as electives where the departmental curriculum so permits.

5.8 In addition to the prescribed credit requirement, a student shall also have to complete the requirements of EAA, carrying no credit points, during the first four semesters. The EAA may be N.S.S., N.C.C., Sports or any other physical activities. The detailed instructions and practices will be imparted and supervised by the concerned faculty and/or officers. EAA course shall have syllabi, instruction, and examinations like academic courses. The class timing of the EAA courses will be chosen differently from the other academic courses, depending on weather conditions. Students will be awarded PP grade for passed or NP grade for not passed in an EAA, which will be recorded in the Grade card, but not taken into account for computing the SPI and CPI (refer clause 14).

5.9 The curricula to be followed in the first year by the students of all the disciplines shall be common.

5.10 The curricula for B.Tech. course will also include an audit course (Sec. 14.3) "Industrial Training" of 4 – 6 weeks duration after the fourth/sixth semester. Industrial/research experience for this course may be obtained in any reputed industry, research laboratory, IIT, NIT or any other organization of comparable repute. Summer internship programme in any IIT/NIT/other organization of comparable repute of at least 4 weeks duration will also be considered as an industrial training course. On completion of the course, the student shall submit a report to the department. The earned grade (PP/NP) shall be reflected in the seventh semester grade card.

The total period of this course may be split into two parts, to be completed during the same or different vacation periods.

5.11 Under special circumstances, a student may be permitted by Head of the concerned department to carry out a mini-project of 4- 6 weeks duration at NIT Silchar in lieu of the external experience Industrial Training course. Such projects should preferably be based on real life industrial or social problems under the supervision of a faculty member of the Institute.

5.12 In addition to regular course work, a UG student must carry out a major project in the final year under the guidance of one or more teachers, known as supervisor(s).

5.13 When circumstances so permit, it will be possible for a student to spend a semester or more in another NIT, IIT or a reputed Institute of comparable standard and transfer the credits to NIT Silchar. In that case, the course, however, need to have a one-to-one correspondence between the participating institutions. The CEC constituted by Senate shall establish the adequacy of the education so received in another institution.

6 Registration

6.1 Every student is required to register, in person, for the approved courses through the assigned Faculty Advisor at the commencement of each semester on the day fixed for such registration and notified in the Academic Calendar. The Dean (Academic) may cancel the registration of one or more courses if they are found to violate some rules or if there are restrictions imposed due to disciplinary reasons.

6.2 Students who do not register on the day announced for the purpose may be permitted late registration under special circumstances only on payment of an additional fee. Normally no late registration shall be permitted after the due date from the scheduled date, except in special cases like those

(i) dictated by counseling authorities in first semester

(ii) a serious and genuine medical illness

(iii) a family calamity or natural calamity stopping the candidate to report for registration on the scheduled date

(iv) participation in a national/international event

All terms and conditions of late registration against case (i) is fully governed by the guidelines of the counseling authorities.

The minimum percentage of attendance requirement of a student registering late will be calculated from the date of their registration. But, no special consideration is admissible in the matter of assessment/evaluation or grading. Late registration is permitted till a specified date as per academic calendar. If a student does not register within the specified date, he/she is automatically demoted and he/she may register for the same during the next year in the same semester without any extension of the total allowed duration of study.

However, under very exceptional, unforeseen, and unavoidable circumstances late registration beyond the specified deadline may be allowed on case-to-case basis by the Chairman Senate on recommendation of the Dean (Academic). This is possible only when the reasons cited are genuine and the authorities are satisfied with the same. In this case, the total attendance requirement shall be calculated from the last date of late registration.

6.3 Only those students will be permitted to register in the next semester who have

- cleared all dues of the Institute, Hostel, and Library and fines (if any) of the previous semesters
- paid all required advance payments of Institute and Hostel dues for the current semester
- cleared the minimum academic requirements
- not been debarred from registering on any specific ground.

6.4 When a student registers a course for the first time, the said course is called a regular course for the given student. The minimum attendance requirement must be fulfilled by the student to become eligible to appear examinations for a regular course.

6.5 When a student registers for a theory course with "F" grade, the said course can be registered as a regular or compartmental course with an additional fee of Rs. 400/- per course.

If the course is registered as a regular course, he/she has to fulfill the minimum attendance requirement and his/her performance assessment shall be done as per clause 15.

On the other hand, attending classes is not mandatory when the course is registered as a compartmental course. However, he/she has to appear the mid and end semesters examinations compulsorily. No fresh sessional assessment shall be done. The overall assessment is based on the performance of these two (mid and end semester) examinations and already secured sessional mark of that course registered last as a regular course.

6.6 During registration following conditions must be fulfilled:

(a) Normally, the maximum allowed number of credits registered for a semester is limited to 48. However, under special circumstances, the Dean (Academic) may permit a student to register for a maximum of 54 credits including compartmental subjects.

(b) Students who obtained 'F' grade in any compulsory course in any semester may clear it in the re-examination. Else, he/she has to register the course in a next appropriate semester when it is offered.

(c) Those who obtain 'F' grade in an elective subject in any semester may clear it in the re-examination. Alternatively, he/she may register for any elective subject from within the same group of electives offered in a next appropriate semester.

(d) In case of failure in a project or in any course having practical component, the student will have to re-register for it in the next appropriate semester as regular course.

(e) Similarly, in case of failure in courses categorized as EAA the student will have to re-register for it in the appropriate semester of the next academic session as a regular course.

6.7 When a student obtains 'F' grades in more than six subjects in a year (after the even semester) he/she may opt for demotion for improving his/her academic performance. For a demoted student, all the courses in the demoted semesters are treated as regular courses.

6.8 Once a student appears his/her eighth semester end Semester Examinations, he/she has to leave the hostel. Subsequently, he/she is to register all the 'F' graded subjects, as the case may be, and attend classes (if required) with his/her own residential arrangement.

6.9 Students may add and drop subject(s) with the concurrence of the Faculty Advisor, and with intimation to the concerned course coordinator and the academic section provided this is done within the date mentioned in the Academic Calendar and as per the conditions given in clause 6.5.

6.10 If the CPI falls below 6.00 a student may enter a slow pace programme in his/her own interest. In a slow pace programme, a student is to re-register in the lower semester for all the 'F' grade courses as regular courses. However, these students are not eligible for any prize or medal.

6.11 A student must continue his/her registration in Institute till he/she completes all the requirements for the award of the degree by paying prescribed fees even if he/she is registered for no course in a particular semester [A situation of "zero course" registration shall arise when a student has cleared all courses except some even or odd semester course(s).]

6.12 A 'F' graded course must be registered as a regular course only, when the awarded 'F' grade is because of one or more of the following reasons.

- as a measure of disciplinary action
- for adopting malpractice at an examination
- unsatisfactory attendance

7 Attendance

7.1 Attendance in all Lectures, Tutorials, Practicals, and Workshops etc. in each subject must be at least 75 percent of the total classes. A student will not be allowed to write the end semester examination and is automatically awarded F grade in a subject, if his/her attendance falls below 75% in that subject.

7.2 This minimum attendance requirement (75%) is also applicable to EAA, i.e., NCC, NSS, NSO etc., including camps and some other pre-notified programmes covered under EAA.

7.3 For the purpose of calculating percentage attendance, the Dean (Academic) will fix a cut off date before every end semester examination.

7.4 In case there are truly exceptional circumstances, the Senate or the Chairman, Senate, may relax attendance requirements (with reduction of grade by at least one grade) as deemed fit.

7.5 After the end of first month from the starting of classes DUPC shall take up the matter of attendance of the students and shall warn the students who will have shortage of attendance. After the second month, DUPC again shall review the attendance of the students and shall caution the concerned students accordingly with a copy to the guardian/parents, and the Dean (Academic) of the Institute. If the course coordinator so desires, additional classes may be arranged within the semester to cover shortage of attendance.

8 Leave of Absence

8.1 For a period of leave upto two weeks, prior application for leave shall have to be submitted to the Head of the department concerned stating fully the reasons for the leave requested for along with supporting document(s). Such leave will be granted by the Head of the Department.

8.2 Absence for a period not exceeding two weeks in a semester due to sickness or any other un-avoidable reasons for which prior application could not be made may be condoned by the Head of the Department provided he/she is satisfied with the explanation.

8.3 If the period of absence is likely to exceed two weeks and within one month, a prior application for grant of leave will have to be submitted through the Head of the Department to the Dean (Academic) with supporting documents in each case. The decision to grant leave shall be taken by the Dean (Academic) on the recommendation of the Head of the Department.

8.4 On receipt of a leave application, the Dean (Academic) may decide whether the student be asked to withdraw from the course for that particular semester because of long absence.

8.5 It will be the responsibility of the student to intimate the Assoc. warden of the hostel in which he/she is residing and the concerned course coordinator/Head about his/her absence before availing the leave.

8.6 The Chairman Senate may approve leave of absence beyond one month on ground of prolonged illness or unusually serious circumstances. Consideration will be given to students who give prior and continuous information either directly or through parents, project supervisor(s) or faculty Counselor/Advisor. Family functions (social or religious), illness of family members, participation in student activities such as organizing functions or raising money, preparing for other examinations or searching of jobs are not adequate grounds for leave of absence from classes (including project work).

8.7 The leave of absence as per clauses 8.1 – 8.6 will not be condoned for attendance. Form AC/105 is to be used for applying such leave of absences.

8.8 Form AC/106 will be used by students seeking permission, with or without financial support to travel for authorized academic or extra curricular activities. Such absence from classes may be condoned for attendance. However, it is the responsibility of the students to furnish relevant sanctioned documents to the concerned Head. The student is also required to take permission of the Assoc. Warden of his/her hostel in case of any absence from the hostel.

9 Duration of the Program

Normally a student should complete all the requirements for undergraduate programme in eight semesters. However, academically weaker students who do not fulfill some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 12 consecutive semesters (from the first semester registration) to complete all the requirements of the degree.

10 Temporary Withdrawal from the Institute

10.1 A student who has been admitted to an undergraduate programme of the Institute may be permitted to withdraw temporarily from the Institute on the grounds of serious or prolonged illness or grave calamity in the family for a period of one semester or more, provided:

(a) He/she applies to the Institute within at least 6 weeks of the commencement of the semester or from the date he last attended his/her classes whichever is earlier, stating fully the reasons for withdrawal together with supporting documents and endorsement of his/her guardian.

(b) The Institute is satisfied that, counting the period of withdrawal, the student is likely to complete his/her requirements of the B.Tech. degree within the time limit of six years.

(c) There are no outstanding dues or demands in the Institute/Hostel/Library/NCC/NSO/Department.

10.2 A student who has been granted temporary withdrawal from the Institute under the provisions of clause 10.1 will be required to pay fees/charges (except tuition fees and hostel dues) till such time as his/her name is on the Roll List. However, any fees once paid will not be returned.

10.3 Normally, a student will be permitted only one such temporary withdrawal during his/her tenure as a student of the undergraduate programme.

11 Restriction/Termination from the Programme

A student is required to leave the Institute on the following grounds:

(a) If a student is absent for more than one month in a semester without sanctioned leave or intimation to Dean (Academic) his/her name will be struck off the rolls.

(b) A student may also be required to leave the Institute on disciplinary grounds on the recommendations of the Students Disciplinary Committee.

(c) On having been found to have produced false documents or having made false declaration at the time of seeking admission

(d) On having been found to be pursuing regular studies and /or correspondence courses (Leading to degree or diploma) in any other college, university or an educational Institution.

(e) On having been found to be concurrently employed and performing duty or carrying out business in contravention to academic schedule of the Institute and without approval from the Institute.

(f) On having been found in any activities which may tarnish the image of the Institute.

12 Conduct and Discipline

12.1 Students shall conduct themselves within and outside the precincts of the Institute in a manner befitting the students of an Institute of national importance.

12.2 As per the order of the Hon'ble Supreme Court of India, ragging in any form is banned: acts of ragging will be considered as gross indiscipline and will be severely dealt with.

12.3 The following acts shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

(a) Ragging

(b) Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus.

(c) Willful damage or stealthy removal of any property/belongings of the Institute/Hostel or of fellow students.

(d) Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs

(e) Mutilation or unauthorized possession of library books

(f) Hacking in computer systems (such as entering other person's area without prior permission, manipulation and/or damage of computer hardware and software etc.)

(g) Furnishing false statement to the disciplinary committee, or willfully withholding information relevant to an enquiry.

(h) Organizing or participating in any activity that has potential for driving fellow students along lines of religion, caste, home state, batch of admission, hostel or any other unhealthy criterion.

(i) Resorting to noisy and unseemly behavior, disturbing studies of fellow students.

(j) Physical or mental harassment of freshers through physical contact or oral abuse.

(k) Adoption of unfair means in the examination.

(l) Organizing or participating in any group activity except purely academic and scientific programmes in company with others in or outside the campus without prior permission of the Dean (SW).

(m) Disturbing in drunken state or otherwise an incident in academic or student function or any other public event.

(n) Not obeying traffic rules in campus, not following safety practices or causing potential danger to oneself or other persons in any way.

(o) Any other act of gross indiscipline.

Commensurate with the gravity of the offence, the punishment may be reprimand, fine, and expulsion from the hostel, debarment from an examination, rustication for a specified period or even outright expulsion from the Institute.

12.4 For an offence committed in (a) a hostel (b) a department or in a classroom and (c) elsewhere, the Assoc. Warden, the Head of the Department and the Dean (SW), respectively, shall have the authority to reprimand or impose fine. All cases involving punishment other than reprimand shall be reported to the Chairman, Students Disciplinary Committee.

12.5 All major acts of indiscipline, which may have serious implications on the general body of students, and/or which may warrant a formalized nature of investigation, shall be handled by the Students Disciplinary Committee, appointed by the Senate.

12.6 Cases of adoption of unfair means in an examination shall be reported to the Dean (Academic) for taking appropriate action.

12.7 In the event of a

(i) Minor punishment, the aggrieved party shall have the right to appeal to Chairman, Senate.

(ii) Major punishment, the aggrieved party shall have the right to appeal to the Senate, through Dean (A).

Overall conduct and discipline shall be governed by the rules appended in annexure I.

13 Change of Discipline or Branch

13.1 Normally a student admitted to a particular discipline of the UG programme will continue studying in that branch till completion.

13.2 However, the Institute may permit a student admitted as per clause 1.1 to change from one branch of studies to another after the first two semesters. Such changes will be permitted, in accordance with the provisions laid down hereinafter, from a B.Tech programme in any branch to a B.Tech. programme in any other branch.

13.3 Only those students will be eligible for consideration of a change of branch after the second semester, who have

(a) Completed all the common credits required in the first two semesters of their studies, in their first attempt without having had to pass any course in the re- examination.

(b) Obtained a CPI of not less than 8.00 at the end of the second semester.

13.4 Applications for a change of branch must be made by intending eligible students in the prescribed form (AC/109). The Dean (Academic)/Deputy Registrar (Academic) /Assistant Registrar (Academic) will call for applications in the beginning of the odd semester of each academic year and completed forms must be submitted by the last date specified in the notification.

13.5 Students may enlist up to three choices of branch, in order of preference, to which they wish to change over. It will not be permissible to alter the choice after the application has been submitted.

13.6 Change of branch shall be made strictly in order of merit of the applicants. For this purpose, the CPI obtained at the end of the second semester shall be considered. In case of a tie, the AIEEE/JEE rank of the applicants will be considered.

13.7 The applicants may be allowed a change in branch, strictly in order of *inter se* merit, subject to the limitation that the strength of a branch should not fall below/go up by more than ten percent of the sanctioned strength. However, Dean (Academic) will have the power not to change the sanctioned strength of any department considering the limited space in class room and laboratory and other facilities available in the department.

13.8 All changes of branch made in accordance with the above rules will be effective only during the beginning of the third semester of study of the applicant concerned. No change of branch shall be permitted after wards.

13.9 All changes of branch will be final and binding on the applicants. No students will be permitted, under any circumstances, to refuse the change of branch so offered.

14 GRADING SYSTEM

14.1 Subjects Covered under Theory, Practical, and Project (Credit Courses)

Based on the performance of a student, each student is awarded a final letter grade in each theory and practical subject, including project, at the end of the semester. The letter grades and the corresponding grade points are as follows:

Grade	Points
AA	10
AB	9
BC	8
CC	6
CD	5
DD	4
F	0

In addition, there shall be one transitional grade 'I', stands for incomplete grade, may be used by the course coordinators.

14.1.1 **The Transitional Grade 'I'**

(a) The teacher of a subject may award the grade 'I' to a student if the concerned student was compelled to remain absent from the end semester examination on account of (i) Illness or accident which disabled him/her from appearing the examination, (ii) A calamity in the family at the time of the examination, which, in the opinion of the Institute/course coordinator, required the student to remain away from the campus. In case the appeal of the concerned student is not considered by the course coordinator, he/she may apply to Dean (Academic) for a final decision in awarding 'I' grade. A student will be eligible for the award of grade 'I' only if his/her attendance at classes and performance in other components of assessment are complete and satisfactory in the opinion of the course coordinator.

(b) An awarded 'I' grade must be converted by the concerned course coordinator to an appropriate letter grades and communicated to the Academic Section within the prescribed date. Any outstanding 'I' grade after the prescribed date will be automatically converted to 'F' grade.

14.1.2 A student is considered to have completed a subject successfully and earned the specified credits if he/she secures a letter grade other than 'F' in that subject. A letter grade 'F' in any subject implies a failure in that subject.

14.1.3 Semester Performance Index (SPI)

SPI will be computed for each semester as follows:

$$\text{SPI} = \frac{C_1 G_1 + C_2 G_2 + \text{L} + C_n G_n}{C_1 + C_2 + \text{L} + C_n}$$

Where n is the number of courses registered for the semester, C_i is the total credit allotted for the *ith* course, and G_i is the grade points (as defined in 14.1) awarded in the *ith* course.

14.1.4 Cumulative Performance Index (CPI)

CPI will be computed at the end of each semester and communicated to the students along with the SPI in the form of a grade card. The CPI gives the cumulative performance of the student from the first semester up to the end of the semester to which it refers, and will be calculated as follows:

$$\text{CPI} = \frac{C_1G_1 + C_2G_2 + \text{L} + C_mG_m}{C_1 + C_2 + \text{L} + C_m}$$

Where m is the number of courses registered upto that semester, C_i and G_i as defined above (14.1.3).

Whenever a student repeats or substitutes a course in any semester, the lower grade obtained by him/her in the course is to be ignored in the computation of CPI from that semester onwards.

14.1.5 Both SPI and CPI will be rounded off to second place of decimal and recorded as such. Whenever these CPI are to be used for the purpose of determining the merit ranking of a group of students, only the rounded off values will be used.

14.2 Non-Credit Subjects Under EAA

In all the EAA subjects, student will be awarded following two grades viz., 'PP' – Passed and 'NP' – Not Passed. No grade points are associated with these grades and performances in these subjects are not taken into account in the calculation of the SPI or CPI. However, the award of the degree is subject to obtaining a 'PP' grade in all these subjects.

14.3 Audit Courses

A course is called an "audit course" for a given student when it is neither compulsory nor any credit earned is taken into consideration for SPI or CPI calculation. The faculty advisor may permit a student to register for an audit course provided the course coordinator allows auditing the course. The word "AU" shall be written alongside the course name in the grade card. Pass or fail status will be shown in the grade card as "PP" for passed and "NP" for not passed. However, a student is not required to register again for passing a failed audit course as the course is not compulsory to earn the degree.

14.4 Conversion of Grades

The Institute adopts a 10 point scale for conversion of grade to equivalent percentage of marks. For example, CPI 7.0 is equivalent of 70% of marks, CPI 6.25 is equivalent to 62.5% etc.

15 Assessment of Performance

There will be continuous assessment of a student's performance throughout the semester and grades will be awarded by the concerned course coordinator or the appropriate committee appointed for this purpose on the following basis.

15.1 Theory Subjects

(i) The evaluation will be based on performances on the minor test, mid semester examination, end semester examination, and internal assessment. The combined assessment of minor test and internal assessment is known as sessional assessment.

(ii) Centralized examinations are conducted for the mid and end semester examinations for one and two hours durations, respectively. The minor test is conducted by the course coordinator in a suitable time between the mid and end semester examinations of durations varying between one hour to three hours, to be decided by the course coordinator.

(iii) The internal assessment is based on students' performance in class test/quiz/viva/assignment/ class impression/attendance etc., as decided by the course coordinator and declared at the start of the semester.

(iv) The overall performance in a course is decided by the following component-wise weightage:

Components		**% weightage**
Mid semester exam		30%
End semester exam		50%
Sessional assessment	Minor test	10%
	Internal assessment	10%

15.2 Practical Subjects

The evaluation will be on the basis of attendance, assessment of the tasks assigned including experimental works, and the test/viva/exam, to be decided by the concerned department/course coordinator. As such, the assessment procedure may vary from department to department or instructor to instructor. However, the evaluation procedure needs to be declared by the course coordinator at the beginning of the semester.

15.3 Project Works

The projects normally consist of two stages, each spread over a semester. At the end of first stage the student is required to submit a preliminary report of his/her work by a prescribed date to the Project Coordinator/Secretary, DUPC and present it to a Project Evaluation Committee. The second stage of work is continued in the following semester.

The second stage of project work is also evaluated in the same manner as in the first stage. However, in the second stage the students are required to submit unbounded copies of the report for examination. On successful completion of the oral examination, each student will be required to submit corrected bound copies of the project report one each to the department and the supervisor(s) as per the standard format.

Evaluation of both the stages of the project work will be carried out separately and is based on project/sessional work assigned by the teacher (supervisor), seminar, project report, and assessment by project evaluation board (to be constituted by Head).

For the purpose of awarding grades, the following will be weightage of the different components in each semester.

components	% weightage
Mid semester assessment by Supervisor	20%
Mid semester assessment by Evaluation Board	20%
End semester assessment by Supervisor	20%
End semester assessment by Evaluation Board	20%
Project report (assessed by Evaluation Board)	20%

Extension of time usually not exceeding 3 months from the announced last date for submission of the project report may be granted by the DUPC in the case of students with insufficient progress in the project work. In such a case the concerned students will be awarded 'I' grade. Furthermore, his/her result shall be kept withheld until the awarded "I" grade is converted to a valid grade by the deadline. As usual, if the "I" grade is not converted to a valid grade within the given deadline, it will automatically be converted to 'F' grade.

Those who fail (F grade) in any of the stages of the projects are required to re-register for the same in the following corresponding semester.

Students are encouraged to work on research topics with a potential for creation of new technologies and patents. Rights to all intellectual property generated in project shall be distributed equally among the students, technicians, and the supervisors, except where the concerned workers mutually settle on a distribution formula. If a project is supported by a sponsor, the sponsoring organization will be given intellectual property right as per the contract, and the balance divided among the faculty, students, and technicians.

15.4 Subjects Covered under EAA

Evaluation procedure of all the subjects covered under EAA is decided by the grade awarding authority and declared at the beginning of the semester.

16 Award of Grades

16.1 Theory, Practical, and Project Courses

Total marks for which a student is evaluated in a subject will be finally normalized to 100 and a relative grading patter shall be followed, subject to the lower cutoff for a minimum pass grade (DD) shall be as follows:

First year courses: 30

Second year onwards: 35

The awarded grade shall be scrutinized and approved by DUPC before forwarding to the academic office.

The results of performance of the students in the semester examinations shall be announced by the teachers of the subjects concerned. It is mandatory for the course coordinator to show all evaluated answer scripts to the students during the stipulated period as mentioned in the academic calendar. For end semester examinations, normally the answer scripts are to be shown within the first week of the commencement of next semester classes. The students should point out discrepancies in the evaluation by the coordinator, if any, on the spot.

16.2 Audit Courses

As mentioned in Sec. 14.3, awarded grade shall be either 'PP' (≥ 30) or 'NP' (< 30).

16.3 Extra Academic Activities

As explained in 15.5, evaluation of performance in Extra Academic Activities will be done by the authorities conducting them and they will directly communicate grades to the Academic Section.

17 Preserving Answer Scripts and Marks

End semester examination answer scripts shall be preserved by the teacher(s) concerned for a period of one semester. However, the sheet containing details of marks converted to grades must be preserved by DUPC till the students complete their course of study.

18 Submission of Grades

18.1 Courses Other than EAA Courses

The final grades for a subject must be submitted by the course coordinator(s) after the end semester examination to their Chairman, DUPC for scrutiny and approval by DUPC and onward transmission by the Chairman, DUPC to the Academic section within the specified date.

18.2 EAA Courses

As explained in 16.4, evaluation of performance in Extra Academic Activities will be done by the authorities conducting them and they will directly communicate grades to the Academic Section

19 Changes in Grades and Grievance Redressal

19.1 Changes in Grades

After seeing the end semester answer script, if a student feels that the marks awarded in a course is not justified, he/she may request the course coordinator for a review of the awarded marks. The course coordinator, if satisfied, may review the awarded marks, make a correction to the grade (if required), and send the same to Dean

(Academic), with due justification for a change in grade. Such a correction must be done within one week of the start of the next semester or the due date specified in the academic calendar. Beyond this, no change in grade shall be entertained under any circumstance.

19.2 **Grievance Redressal**

If a student is not satisfied with the mid semester evaluation in a theory subject, he/she may approach the Chairman, DUPC for a review. The DUPC shall review the matter and decision of the DUPC in this regard shall be final.

However, if the student is not satisfied with the course coordinator's evaluation in the end semester examination of a theory subject, he/she may approach the Chairman, DUPC for a review of the awarded marks/grade within two working days from the last date of submission of the corrected grade as per academic calendar. On receiving such a prayer, DUPC shall review the matter and intimate the Academic Section regarding change of grade (if any) within seven working days from the last date of submission of the corrected grade.

In case, the student is not satisfied with the review of the DUPC, he/she shall have the option to approach the Dean (Academic). Dean (Academic) in consultation with the Chairman, Senate shall do the needful in this regard and his/her decision shall be the final and no further appeal will be entertained. Such appeal shall be entertained only upto three weeks from the date of commencement of classes of next semester. No appeal, what so ever, shall be entertained after the stipulated time mentioned above.

20 Examinations

In assessing the students' attainment in subjects (Theory and Practical), seminars, project work, EAA etc., the system of continuous assessment is adopted by the Institute. In conformity with this practice, there will be one mid semester examination and one end semester examination for every theoretical subject, in addition to minor test, and internal assessment. The mid semester and the end semester examination will be conducted centrally by the Academic Section of the Institute. The class test or quizzes will be organized by the concerned course coordinator(s).

20.1 A student may be debarred from appearing in the end semester examination due to the following reasons:

(a) If any disciplinary action is taken against him/her.
(b) If his/her attendance in the Lecture/Tutorial /Practical classes has not been satisfactory during the semester.

20.2 The Institute shall provide sick room facility inside the Institute building or in a nearby hospital as deemed convenient by the Institute to assist students who may fall sick during the examinations

20.3 The examinations will normally be "closed book type", where the students are not permitted to bring any material from home or hostel. All necessary charts and tables will be provided by the Institute. It is the course coordinators responsibility to recommend the materials to be provided, and to check with the Examination office that the arrangement has indeed been done. While normal scientific calculators are permitted, other electronic devices such as programmable calculators and calculators containing communication devices, MOBILE phones are forbidden in the examination halls. If such devices are found to be possessed,

- The possessors shall forfeit the devices to the Institute
- It will be treated to be an unfair means in examinations and dealt with as per conduct and discipline rules

Any exception to these provisions must be specially approved by the Senate.

20.4 All question papers submitted by the teachers will be treated as "confidential documents" till the end of the examination of the subject concerned. It is an open document after the examination is over. The institute will archive question papers in physical and electronic form, and make them available to future students.

20.5 In the event of final year student failing in a Laboratory subject and/or Project work, the teacher concerned may, at his/her discretion, grant the student an extension of time not exceeding 3 months and award an 'I' grade. If no such extension is given to a student he/she have to re-register for the same requirement in the earliest succeeding semester in which it is offered.

20.6 If it is medical ground, the student has to submit the medical certificate from the Institute Doctor or the recommendation of the Institute Doctor for treatment elsewhere. In case of treatment outside the Institute including hospitals referred by the Institute, the student must produce all medical documents (discharge certificate, prescriptions, visit slips, pathological reports, medicine purchase receipts etc.) in original. The reason for leaving the campus must also be genuine and with permission of competent authority. In case of family calamity the student's application must be supported by a letter from the parent/guardian along with copies of documents such as medical records, death certificates (if that happens).

21 Student Feed Back

Course Evaluation form (AC/109) submitted by a student will assist a teacher to improve the contents and delivery. It is the duty of every student to give his/her thoughtful response to the queries given in the Form. It is mandatory for a student to submit the form soon after completion of a course. The Dean (Academic) office will issue a notice mentioning how the form will be submitted.

22 Re-examinations

22.1 Students who obtain an 'F' grade in one or more subjects of the just concluded End-Semester Examination may appear in the Re-examination to clear one or more subjects in which he/she failed to obtain a higher grade. However, if the awarded 'F' grade is due to any one or more of the reasons stated in clause 6.12, he/she is not eligible to write the re-examination.

For appearing in one or more subjects in Re-examination, students are to apply to Dean (Academic)/Deputy Registrar (Academic)/Assistant Registrar (Academic affairs) and pay the requisite re-examination fee.

22.2 There is no limit on number of subjects for which a student will sit for a re-examination. Two grade sheets will be issued to all those students who will sit for the re-examination. The final grade sheet/transcript will show two grades obtained by a student from these two examinations. Since both the question papers will be of the same standard, there will be no reduction of grade for the re-examination.

22.3 Also students who have missed an end semester examination on valid reasons and awarded 'I' grade are eligible to appear the re-examination. Of course, unlike 'F' graded course, no separate grade card will be issued.

22.4 No re-examination will be scheduled for the mid semester examination and minor test. In case of absentees, it is entirely up to the course coordinator to ascertain the proficiency of the student by whatever means considered appropriate if he/she is satisfied of the bonafides of the cases.

22.5 Re-examinations will be held as per dates notified in the Academic Calendar.

23 Withholding of Grades

Grades shall be withheld when the student has not paid his/her dues or when there is a disciplinary action pending against him/her. Also the results shall remain withheld as per clause 20.5.

24 Eligibility for the Award of B.Tech. Degree

24.1 A student shall be declared to be eligible for the award of B.Tech. degree if he/she has

(a) Completed all the credit requirements for the degree with grade 'DD' or higher grade in each of the subjects (Theoretical, Laboratory, Workshop etc.), Seminar, Project etc.
(b) Satisfactorily completed all the non-credit requirements for the degree viz.- Extra Academic Activities etc.
(c) No dues to the Institute, Department, Hostels, NCC and NSO; and
(d) No disciplinary action is pending against him.

24.2 The award of B.Tech. degree must be recommended by the Senate and approved by the Board of Governors of the Institute.

DEPARTMENTAL UNDERGRADUATE PROGRAMME COMMITTEE (DUPC)

Composition:

(i)	Head of the Department (ex-officio)	Chairman
(ii)	50% of the faculty members of the Department with a maximum of eight or a minimum of three faculty members to be nominated by the Head of which one will be nominated as the Member Secretary.	Members
(iii)	One faculty member from another department. The department will be chosen by the committee. The faculty member from the chosen department will be nominated by the Head of the concerned department.	Member
(iv)	Two students with CPI not less than 7.5 to be nominated by the following committee	Members

(a) Dean (Academic) : Member and Convenor

(b) Dean (SW) : Member

(c) Dean (R & C) : Member

(d) Head of the concerned department : Member

Tenure:

Two years for faculty members and one year for student members.

Functions:

(a) To oversee the conduct of all undergraduate courses of the department.
(b) To ensure academic standard and excellence of the courses offered by the department.
(c) To discuss and recommend the syllabi of all the undergraduate courses offered by the department from time to time before sending the same to the Senate
(d) To consider any matter related to the undergraduate programme of the department.

Annexure I

Conduct and Discipline Rules for the Students of NIT Silchar

Following rules shall be in force to govern the conduct and discipline of all students:

1. Students shall show due respect to the teachers of the Institute, the Assoc. Wardens of the Hostels, the Sports Officers and the Officers of the National Cadet Crops; proper courtesy should also be extended to the employees of the Institute and of the Hostels. They shall also pay due attention and courtesy to visitors.

2. Students are required to develop a friendly relationship with fellow students. In particular, they are expected to show kindness and consideration to the new students admitted to the Institute every year. Law bans ragging in any form to anybody. Any act of physical or mental pressurization of junior students, individually or in group, will be considered as an act of ragging. Ragging also includes forcing junior students to meet seniors outside institute premises, or in places where a student has no valid reason to be present, asking irrelevant questions or using abusive language. Ragging will be considered as gross indiscipline and will be severely dealt with, which may include expulsion from the institute.

   Any incident of ragging inside or outside the campus must be reported to an Assoc. warden, the chief warden or a faculty member designated to look after ragging issues by any student, senior or fresher, who has witnessed an incident. Failure to report a ragging incident will be considered a serious offence, even if one is not personally involved in it. If a junior student yields to any form of ragging by senior students and does not inform the Institute or hostel authorities, or willfully withholds the information in an enquiry of ragging incident, the matter will be treated as indiscipline on the part of the junior student and invite punishment comparable to those against ragging itself. Willful withholding of complaint by a junior student does not automatically exempt a senior from punishment.

3. The following acts of omission and/or commission and comparable offences shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

- Furnishing false statement of any kind in the form of application for admission or for award of scholarship or prizes etc.
- Furnishing false statement to the Disciplinary Committee, or willfully withholding information relevant to an inquiry.
- Organizing or participating in any activity that has potential for driving fellow students along lines of religion, caste, home state, batch of admission, hostel or any other unhealthy criterion.
- Physical or mental harassment of freshers through physical contact or oral abuse.
- Getting involved in a brawl or fight with persons outside the Institute, either alone or in a group, irrespective of who initiated the conflict.
- Willfully damaging or stealthily removing any property belongings of the Institute, Hostels or fellow students.
- Adoption of unfair means in the examinations.
- Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
- Organizing or participating in any group activity except purely academic and scientific programmes in company with others in or outside the campus without prior permission of the Dean of Student Welfare.
- Mutilation or unauthorized possession of library books.
- Not cooperating with faculty, officers or security personnel investigating a disciplinary issue.
- Resorting to noisy and unseemly behavior, disturbing studies of fellow students.
- Disturbing in drunken state or otherwise an incident an academic or student function or any other public event.
- Not obeying traffic rules on campus, not following safety practices or causing potential danger to oneself or other persons in any way.
- Displaying lack of courtesy and decorum, resorting to indecent behavior any where within or outside the campus.
- Not intimating his/her absence to the Assoc. Warden of the hostel before leaving campus.
- Getting involved in an activity that violates state or national laws.

4. Commensurate with the gravity of the offence, the punishment may be
   - 4.1 Reprimand,
   - 4.2 Additional work in the institute,
   - 4.3 Debarment from student activities and elections and captaincy of sports teams,
   - 4.4 Partial (one month or one semester) or c
   - 4.5 complete debarment from campus placement,
   - 4.6 Reduction in grade in one or more courses,
   - 4.7 Award of F or NP, as the case may be, grade in one or more courses with or without forcing to study in slow pace,
   - 4.8 Expulsion from the hostel,

4.9 Rustication for a specified period, or

4.10 Outright expulsion from the Institute.

Punishments under items 4.5 – 4.9 will constitute "Major Punishments" and will debar a student from all academic medals and prizes, as well as important non-academic awards. In addition, for economic offences (either misappropriation of money or damage to Institute property), the cost to the Institute will be recovered along with a penalty which may be up to ten times of the cost recovered.

5. For a minor offence committed (a) in a hostel, (b) in the department or a class room and (c) elsewhere, the Assoc. warden, the head of the department and the dean of student welfare, respectively, shall have the authority to reprimand, impose fine or take any other suitable measure. All cases involving punishment other than reprimand or fine shall be reported to the chairman of the standing disciplinary committee in a formal manner.

6(a) All major acts of indiscipline, which may have serious repercussion on the students in general and/or which may warrant a uniform and more formalized nature of investigation, shall be handled by the Standing Institute Disciplinary Committee appointed by Senate. The standing Disciplinary Committee consists of the following ex-officio and other members:

(i)	Dean of Student Welfare	: Chairman
(ii)	Chief Warden	: Members
(iii)	Two members of faculty nominated by the Senate, for a period of two years	: Members
(iv)	Two senior students nominated by the Director for a period of one year	: Members
(v)	Deputy/Asst. Registrar (Academic)	: Member Secretary
(vi)	Assoc. Wardens of the hostels of the concerned students, Vice Presidents of SAC and other faculty members may be invited to the proceedings of the ISDC at the discretion of the Chairman as per need	

6(b) The standing Disciplinary Committee shall investigate complaints, examine available evidence and award punishment.

6(c) Recommendation of the committee, which will include the suggested punishment in cases of guilt proven, will be forwarded to the Chairman, Senate for necessary action.

6(d) Proof of guilt need not necessarily be at the same level as necessary in a court of law. The committee, in order to protect the academic rights of a greater body of students, may award disciplinary measures if it is reasonably satisfied that such measures are in the greater interest of the students.

6(e) The Director, at his discretion may take additional measures keeping in mind long term issues and impact on other aspects of Institute management. The Director in the capacity of Chairman, Senate may make minor changes in the nature of punishment awarded.

6(f) On approval of Director, the Deputy / Assistant Registrar (Academic) will bring out appropriate orders with copies to the parents / guardians of the student.

6(g) If the Director feels that the nature and/or quantum of punishment is not commensurate with the offence and may create long term problems, he may refer the matter to the full Senate. The Senate's decision in the matter will be final.

7. Acts which may be classed as 'crimes' rather than acts of indiscipline will be reported to the state authorities; they include such acts as causing serious injury to fellow students or others, causing major damage to Institute property, being involved in activities prejudicial to national security or to that maintaining communal harmony etc.

8. Cases of adoption of unfair means in an examination shall be dealt with by the Examination Disciplinary Committee consisting of the following members:

(i)	Dean (Academic)	: Chairman
(ii)	Assoc. Dean (Exam)	: Member
(iii)	The concerned examiner(s) and the invigilator reporting the incident	: Members
(iv)	One faculty member nominated by the Senate for a term of two years	: Members
(v)	Deputy/Asst. Registrar	: Member

	(Academic)/HOS (academic)	Secretary

If adoption of unfair means is proved, the punishment may be, depending on the quantum of the offence and prior record, reduction of grade, de-registration of a course, expulsion for one or more semesters or outright expulsion from the Institute. The Committee shall recommend appropriate measures in each case to the Chairman of the Senate for awarding the punishment. In case of minor offences in the examination hall, the invigilator can enter a punitive deduction of marks on the answer script which will be implemented by the course teacher at the time of evaluation of the script.

9. Any act of indiscipline in a hostel will be investigated by a Hall Disciplinary Committee which will recommend the action to the Assoc. warden, Hostels, who will decide the course of action to be taken and implement it. However, in case the matter is in serious nature, the Assoc. warden will forward it to the Dean (SW) through Chief Warden, Hall. The Dean (SW) who is the Chairman of the standing Institute Disciplinary Committee shall take necessary action. The Hall Disciplinary Committee shall consist of the following members:

(i)	Assoc. Warden	: Chairman
(ii)	General Secretary, Gymkhana	: Members
(iii)	One boarder of the hall to be nominated by the Chief Warden of Hotels in consultation with the Assoc. Warden	: Members

10. Cases of indiscipline in a class room or laboratory can be handled by the class teacher by expelling from the class, marking the student absent for a few classes or penalizing on marks under sessional assessment.

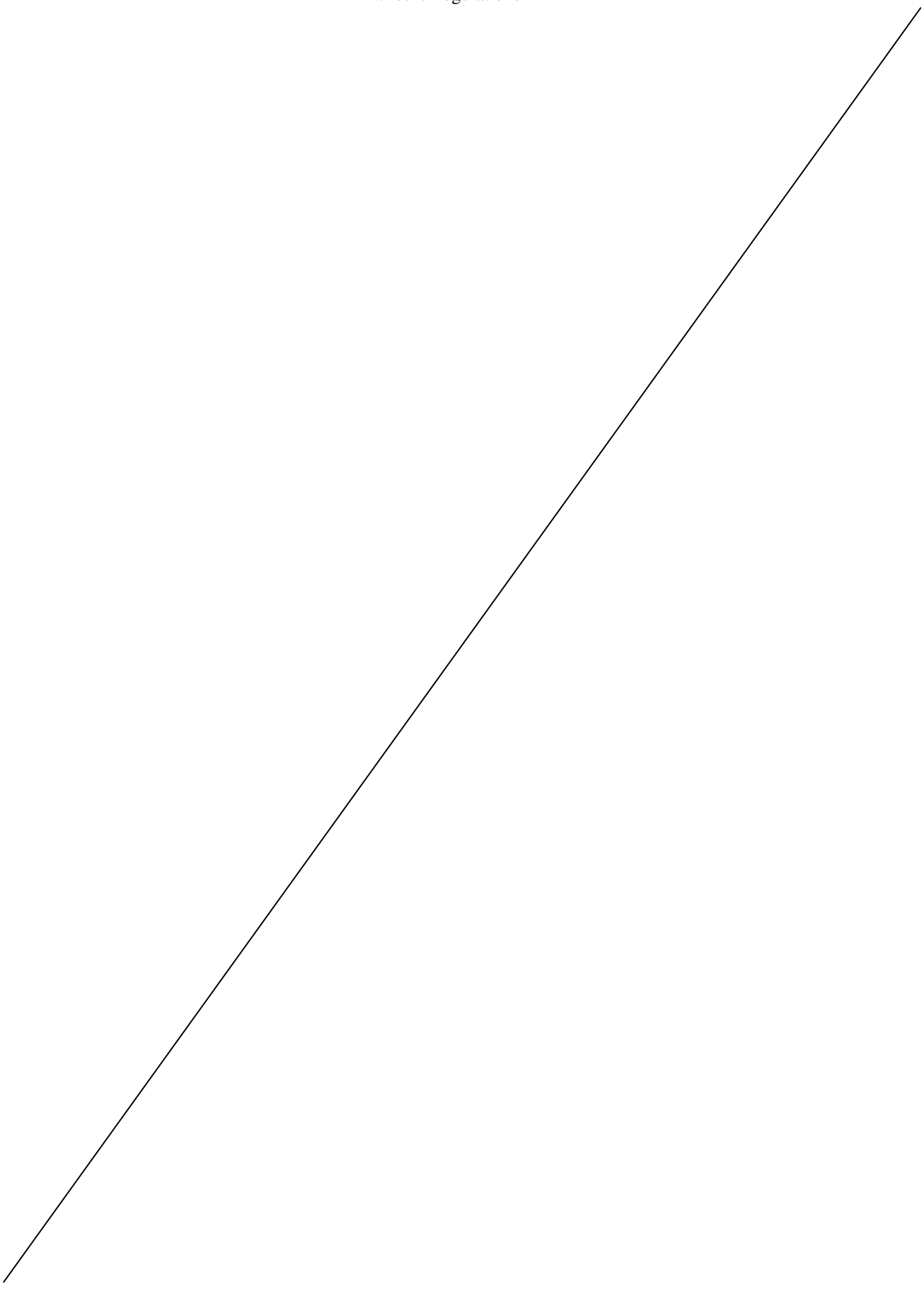
11. An invigilator in an examination hall may recommend deduction of marks (up to 10 marks) on the answer script for indiscipline in the examination hall, disobeying advice of the invigilator or other minor offences. In case of adoption of unfair means or creation of serious disturbance in the examination hall, the invigilator shall report the matter to the examination malpractice committee.

12. Any act of indiscipline and steps taken by the Director will be reported to the Senate in its next meeting. If opportunity still exists, the Senate may deliberate and alter the nature and/or quantum of punishment awarded.

13. A punishment, once awarded and notified cannot be changed by the Director, the Standing Disciplinary Committee, or any administrative authority. However, when new facts come to light, the Senate can amend the punishment and take any other corrective measures that it feels appropriate.

14. Ordinarily minor disciplinary offences and punishments will not be reflected in a students' Conduct Certificate. But in serious cases, Disciplinary Committee, the Director or the Senate may decide to make an appropriate entry in the students' Conduct Certificate.

FORMS



NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

ADDRESS SLIPS

FATHER'S / GUARDIAN'S ADDRESS SLIP

To

Dr. / Shri……...

……..

…….

Pin Code …….State……

FATHER'S / GUARDIAN'S ADDRESS SLIP

To

Dr. / Shri……...

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Pin Code …….State……

FATHER'S / GUARDIAN'S ADDRESS SLIP

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Dr. / Shri……...

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Pin Code …….State……

FATHER'S / GUARDIAN'S ADDRESS SLIP

To

Dr. / Shri……...

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…….

Pin Code …….State……

SPECIMEN SIGNATURE FOR IDENTITY CARD

NAME : _____

1.

2.

3.

NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

REQUEST FOR PERMISSION TO STAY OUTSIDE HOSTEL

1. Name :_____ 2. Roll No._____

3. Programme:_____4. Department_____5. Year _____

6. Reason for not staying in the Hostel:

_____

_____

7. Name & address of with whom student will stay: _____

_____

_____ Phone : _____

8. Relationship with the student: _____

9. Distance from the Institute: _____km.

10. Proposed mode of travel _____
(If proposed to travel by a motor vehicle, a photo copy of Driving licence to be enclosed. I promise to wear safety helmet or seat belt while driving, and promise not to drive in the hostel area.)

11. We certify that adequate physical facility exists for accommodation of Shri / Ms _____ and the place is conducive for studying The place of stay is close to the Campus and the student shall face no difficulty in attending classes and laboratories both during and outside regular working hours. Adequate safety measures will be taken during travel for female students.

    The student shall pay full seat rent for his allotted hostel seat and all other dues (except Mess dues) as decided by the Warden of the Hostel.

12. Signature :

_____	_____	_____
Student	Parent / Guardian	Guardian with whom student will live.

Recommendation :_____

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Faculty Advisor Head of the Department

Approved / Not Approved

Dean, Academic ----------

NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

REQUEST FOR PAYMENT OF FEES THROUGH E-BANKING
(To be submitted on approval of application)

Date: _____

1. Name of the Candidate in full :

2. Regn no : Department :

4. Program :

5. Head of Account and amount of fees to be paid

Sl no	Head of Account	Amount (Rs.)
(i)	Semester Registration fee	
(ii)	Thesis submission fee	
(iii)	Re-examination fee	
(iv)	Summer Course Registration fee	
(v)	Fines	
(vi	Transcripts & Certificates	
(vii)	Hostel dues	

6. I may kindly be permitted to deposit the fees mentioned above in appropriate Institute account through e-banking.

Signature of Student

Permitted to deposit the fees through e-banking. Appropriate entry has been made on the computer for accepting the fees.

Office Assistant (Academic Section) Asst./Deputy Registrar (academic)

To

Assistant/Deputy Registrar (Accounts)

NITS/AC/104

National Institute of Technology Silchar

Semester Registration form for B.Tech. Programs

1. Name : 2. Sex :
3. Regn No : 4. Semester :
5. Dept. : 6. Hostel :
6. Date of Registration : 7. Year :
8. Category (Gen/SC/ ST/OBC/Minority) : 9. PH (Y/N) :

7. Subjects Registered:

(a) F Grade subjects not cleared so far, if any:

Semester	Subject code	Subject Name	Credit pts	Subject Registered as		Remarks
				Regular	Compartmental	

(b) Regular Subjects of Current Semester:

Subject code	Subject Name	Credit pts	Remarks

8. Total Credit pts (7(a)+7(b)) :

Signature of the student with date

Signature of the faculty advisor with date

12. Details of Registration Fees paid

Rs.	Receipt no.	Date:

13. Fee for extra load : Rs.

14. Fine : Rs.

15. Any Other Fee : Rs.

16. Total Fees Paid : Rs.

17. CLEARANCE

_____From Hostel	From Library	From Accounts	Other, if any

18. PRESENT ADDRESS

Home ---------- Pin ----------STD Code ---------- Phone/Mobile ----------	Hostel Hostel no. ---------- Room no. ---------- Mobile/contact no. ---------- Email id : ----------

All particulars stated in this Registration Form are true. If any information given by me is found to be false at any stage, I shall be liable to any action that the NIT authority may deem fit and proper.

Date: ---------- Signature of the student ----------

N.B. Students are to retain a Xerox copy before final submission to Academic section.

FOR OFFICE USE ONLY

Received, verified and found in order. Dealing Assistant: …… May be allowed to register and be listed in the appropriate Roll sheet Superintendent: ……	Remarks, if any: Assistant Registrar (Acd): …….. Dean (Academic) …….

Instructions on Semester Registration

1. This form is to be used by every student of NIT SILCHAR at the beginning of a semester. Through this form, the student requests the courses that he/she intends to study during the semester or to write exams as backlog papers.

2. All roll sheets for classes and lists of examiners are from these registration forms. If you forget to mention a course here, you will not have another opportunity to attend classes or to sit in examination on that paper.

3. Please consult Institute time table before filling up this form. There should be no more than one course during a time slot. Please note that no department or teacher or administrator can change the time table later, except with the consent of every single stake holder. Do not ever give your consent to a change of time table if the change would create a conflict in your own schedule.

4. Please choose your electives in a manner that avoids time table conflict.

5. If you have 'F' grades more than one year old, please register for those courses first. You can register the course as a regular or compartmental course. Please refer clause 6.5 of B.Tech rules and regulations for further details.

6. Only after registering for the backlog and repeat courses, register for the current semester courses, starting with the core subjects. Your Faculty Advisor will guide you on choice of courses and electives.

7. If your CPI is low (< 6.00), you are advised to enter the slow pace programme. Do not load yourself excessively and get more F grades in future.

8. You must complete the full B.Tech. programme in 6 years.

9. Attendance in class is extremely important. The minimum attendance should be 75% of total number of classes held in any subject. Absence beyond these limits will mean loss of grade points, and in extreme cases, outright failure. Please do not take the risk.

10. Your Faculty Advisor is your best friend and your interface with the Institute. Always remain in touch with him. Any application to institute authorities should preferably be through your faculty advisor.

NITS/AC/105

NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

APPLICATION FOR LEAVE OF ABSENCE FROM CLASSES

(To be submitted in duplicate to the Department office. Please do not submit to Academic section)
(Please do not use this form for visiting other Institutions/ Industry for academic work)

Type of Leave: ☐ Personal Leave * ☐ Medical Leave **

1. Name :

2 Regn No. : 3. Department :

4. Reasons for seeking leave (Give details):

_____

5. Period : from To
6. No. of working days of absence :
7. Leave already availed during the semester : Medical : Personal:
8 Address during the leave with tel. no.

_____

_____

9. I understand that this leave does not entitle me to extra classes, alternative examination, credit for class tests / home assignments or mess rebate.
10. Enclosures :

* Students can take personal leave only for a serious medical problem in the family, but not for other casual reasons.

** Medical leave may be availed for prolonged illness. Photocopy of medical card with Institute Medical officer's recommendation enclosed. In case of outstation illness, all relevant medical papers (prescriptions, medicine purchase receipts, diagnostic reports etc) are also enclosed along with endorsement by Institute Medical officer.

_____
Signature of the student

Recommended for approval:

_____ _____
Faculty advisor Department Office

☐ Approved (upto two weeks) ☐ Recommended (beyond two weeks)

_____
Head of the Department

☐ Approved (upto one month) ☐ Recommended (beyond one month)

_____
Dean (Acad)

☐ APPROVED

_____
Director

To
Assistant Registrar / HOS (Acad) for records
Copy to: Student concerned (through HOD & Faculty advisor)

NITS/AC/106

NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

Request for permission to travel for academic work, conference or student activity

(Please submit in duplicate if involves absence from classes)

1. Name of student : 2. Regn. No.
3. Hostel of residence :
4. Purpose of travel : Academic Conference Student activity Other
5. Details of activity :
6. Place of visit : Organisation City :
7. Duration of absence including travel From : To :
8. Expenses :

   Round trip train fare in appropriate class (with concession if applicable) : _____

   Local travel : Rs. _____ Living expenses : Rs _____

   Registration fees : Rs _____
9. Special request if any :
10. Enclosures : Correspondence with Institute to be visited

    Acceptance of paper Abstract of paper Conference brochure

    Other _____
11. Signature of student _____ 12. Date _____
12. Recommendation of faculty advisor/thesis supervisor (for project related travel only)

    _____ _____

    Thesis supervisor (if applicable) Faculty advisor

For project work without financial support or with financial support from Research projects	For academic purpose with financial support	For student activity with financial support
Recommendation of Project PI (if applicable) Travel grant will be provided from project _____ Signature of PI _____ Approved Dean (SW) / Prof T & P is requested to issue student concession _____ Head of the Department	Funds will be provided from Departmental operating grant as per rule towards registration fee and/or fees charged by host institution. Supervisor _____ _____ Head of the Department Travel expenses approved. Dean (SW) / Prof T & P is requested to issue student concession Dean (Acad)	May be permitted Head of the Department Funds may be provided from Gymkhana grant as per rules to the extent of Rs _____ _____ V.P./ Secretary of concerned society. Approved Dean (SW)

Policy Regarding Travel Assistance to Students

A student may need travel support under three types of activities:

(a) For academic work such as using an instrument or library in a different institution, or for collecting data as a part of his/her project work

All fees for use of equipment or services are to be borne from the operating grant of the Department

(b) For presenting a paper in a conference based on his/her project/research work or attending a short term or training programme essential for carrying out the proposed research programme .
Participation in a training programme should be justified by the supervisor for long term benefit to the department.

All fees for registration are to be borne from the Project fund or the operating grant of the Department

or

(c) Participating in a student activity such as paper presentation, model competition, poster presentation not based on any mandatory academic assignment.

The Institute will ordinarily bear the expenses towards round trip sleeper class train fare or bus fare, when an official team is led by a faculty member or sports officer. The Institute will bear expenses towards local travel, living expenses and registration fees as decided by the **Student Union body/ Gymkhana**.

This facility is provided only in cases where the student has been nominated to represent the Institute in a national level competition after going through an open competitive process within the Institute. The number of such travel supports and the mode of selection will be decided by the Student Union body.

Regulations:
In cases of (A) and (B), if financial support is requested, the applications should be sent to Dean(AA) through supervisor and HOD. The following documents need to be enclosed with the application.

1. A formal request through this form.
2. Acceptance from the host institute or conference organizers.
3. A brief description of the work to be done or abstract of the paper to be presented.
4. A summary of the research topic being pursued at NIT.

In case of (C), the application should be sent to Dean(SW) through concerned Vice President of the student union body.

No advance will be paid to the student by the Institute. Reimbursement will be made against expenses made on production of proper receipts. The student must claim reimbursement using prescribed form within a week of returning from the journey. Mess rebate as per rules will be available if Warden of the concerned hall is informed before leaving the campus.

Students must submit a copy of the approved form to Academic Section if absence from classes is involved.

Note : Approval of travel against this form shall not entitle a student to alternative mid-sem or end-sem examination or class test.

Financial assistance will be given subject of availability of fund.

NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

MEDICAL CERTIFICATE FOR MISSING EXAMINATIONS

1 . Examination : MID SEMESTER END SEMESTER

2 Name of student : 3 Regn No.

4 Rest advised for the period : _____ to _____

5 Description of medical condition : (The text must bring out the features that make a student incapable of appearing in an examination from a sick bed in the Institute) :

6 For how long the student has been suffering ?

7 Is the student hospitalized or recommended for hospitalization ? (Give details)

8 Other treatment given :

9

The student may be exempted from appearing in examination during the period :

_____ to _____, because he is incapable of writing the examination even from a sick bed or hospital bed.

Signature of Medical Officer

To
Assistant Registrar (Acad)

Approval of Dean (AA)

The student is exempted from appearing in examination during the period recommended under item 9.
_____

Dean (Acad)

- To be issued by Institute Medical Officer on request by a student or his Faculty Advisor, HOD, Warden or Chief Warden.
- Request to be made on the earliest opportunity that a student or a faculty member gets to approach a Medical Officer of the Institute.
- If exempted by Dean (Acad), a student may get an opportunity for an alternative/supplementary examination

NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

REQUEST FOR APPEARING ALTERNATIVE MID SEMESTER / SUPPLEMENTARY END SEMESTER

EXAMINATION (ODD / EVEN) YEAR 20 - 20

. ALTERNATIVE MID SEMESTER SUPPLEMENTARY END SEMESTER

1 Name of student : 2 Regn No.

3 Department : 4. Year of Admission :

5 Papers want to appear

Sl. No.	Subject code	Subject name	L-T-P	Credits	Attendance in class (%)

6 Reasons for missing regular examination (Give complete detail):

(a) Admitted to hospital on recommendation of Institute Medical Officer
[Attach photocopies of medical record book, hospital discharge certificate]

(b) Granted leave of absence by Dean (AA) for family calamity.

(c) Any other _____.

7 Alternative / Supplementary examination fee as per rules may be added to my dues payable during registration for the next semester.

8 Enclosure : Relevant documents and copies of prior communications:

Signature of the student

9 Recommended with following justification :

Faculty advisor Head of the Department

To
Assistant Registrar (Acad)

- To be filled by all students seeking an alternative mid semester or supplementary examination on grounds of illness, family calamity, participation in a national/international event or any other reason..
- Not to be submitted by students securing F grade in examination.

National Institute of Technology Silchar

COURSE EVALUATION FORM

FORM A

DEPARTMENT OF

Instructor **Course No.** **Course Name** **Date** (dd/mm/yy) **1. Session**

- Please respond to each statement carefully. Your independent and well-considered responses will contribute to the Institute's ongoing effort to improve the teaching-learning environment. **DO NOT WRITE YOUR NAME/ROLL NUMBER ANYWHERE**. Detailed comments are welcome.
- **PUT A TICK MARK IN THE APPROPRIATE BOX/CELL.**

1. About myself

		Very poor (1)	Poor (2)	Average (3)	Good (4)	Very good (5)
1.	My attendance in the classes of the course is					
2.	My preparation before going to the class was					
3.	My expected grade in the course is					

2. About the Course

		Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
1.	A detailed course syllabus was provided at the beginning of the course					
2.	Text books were appropriate for the course					
3.	Reference books provided good support for the course					
4.	The course timing in he time-table was appropriate					
5.	The course load was very heavy					
6.	The course was highly enjoyable					

3. About the Instructor

		Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
1.	The course material was organized properly					
2.	The concepts were explained properly					
3.	Classes were held regularly and accordingly to the time-table					
4.	The instructor's voice was clear and understandable					
5.	Black-board work/visual presentations were of good quality					
6.	Topics were covered in a logical sequence					
7.	Assignments were useful and followed the lectures					
8.	Questions and discussions were encouraged					
9.	Evaluation was done regularly and feedback was given					
10.	Overall, the instruction was excellent					

4. About the Tutorials

		Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
1.	Tutorials were held regularly and followed the lectures					
2.	Tutorials clarified basic concepts taught in the lectures					
3.	Tutorials helped in learning problem-solving in a methodical way					
4.	Questions and discussion were encouraged					
5.	Overall, tutorials were useful					

MENTION STRONG AND WEAK POINTS OF THE COURSE/INSTRUCTIONS (WRITE OVERLEAF):

NITS/AC/110

NATIONAL INSTITUTE OF TECHNOLOGY SICHAR

APPLICATION FOR CHANGE OF BRANCH

(Students Are Advised To Go Through the Rules Regarding Change of Branch Mentioned Overleaf Carefully Before Filling The Application Form)

1. NAME (in BLOCK letters) : _____

2. PRESENT BRANCH : _____

3. REGISTRATION NUMBER : _____

4. RANK IN AIEEE : _____

6. PREFERENCES (in terms of Branch)

Order of Preference	Branch
1	
2	
3	

Date: Signature of the student

NOTE: The duly filled in application form should be submitted to the Academic office in person on production of Identity Card on or before the date mentioned in the Academic Calendar/notified by Dean (Academic) by signing on the Roll Sheet. Applications will not be entertained beyond the last date.

(For Office use)

Date of Receipt: _____ CPI (upto to 2nd Sem): _____

Dealing Asst. Assistant Registrar (Academic)

P.T.O.

RULES REGARDING CHANGE OF BRANCH

1. Change of branch may be considered, only if vacancy exists and if no department falls below 10% of its sanctioned strength because of branch change. **However, Dean (Academic) will have the power not to allow for any change of the sanctioned strength of any department considering the limited space in class rooms and laboratories, and other relevant facilities in the department.**
2. Change of Branch is not permissible for the students admitted against the quota for MEA/ICCR/SAARC countries/DASA Scheme, readmitted in the first semester due to any reason.
3. Students whose branch will be changed are advised to submit a no objection certificate from their parents/ guardian on the official date of registration to the 3rd Semester.
4. Application received after the due date will not be considered.
5. Only those students will be eligible for consideration for a change of branch after the second semester who have
   (a) completed all the credits/course prescribed in the 1st and 2nd semesters of their studies, in the first attempt, without having had to pass any course requirement in the re-examination/complementary examination
   (b) must have secured a CPI not less than 8.0 at the end of second semester
   (c) has not been awarded any punishment on disciplinary grounds.
6. Application once submitted can not be withdrawn.
7. Incomplete/over writing application in any reason will be rejected.
8. Change of Branch shall be made strictly on the basis of inter se merit of the applicants. For this purpose the CPI obtained at the end of the Second semester shall only be considered. In case of ties, AIEEE/JEE rank shall be the deciding factor.
9. All changes of branch will be final and binding on the applicants. No student will be permitted, under any circumstances, to refuse the change of branch so offered.
10. Vacancies will be counted at the end of second semester results.